AD NUMBER

AD462466

NEW LIMITATION CHANGE

TO

Approved for public release, distribution unlimited

FROM

Distribution authorized to U.S. Gov't. agencies only; Specific Authority; Feb 1965. Other requests shall be referred to Federal Aviation Agency, Attn: Information Retrieval Branch, Washington, DC 20553.

AUTHORITY

OACSFD ltr, 6 Jan 1966

Report No. RD-65-17

FINAL REPORT

Project No. 150-530-01V

EVALUATION OF FORWARD AREA ASSAULT PLANS FOR ARMY HELICOPTER OPERATION

FEBRUARY 1965

FEDERAL AVIATION AGENCY
Systems Research & Development Service
Atlantic City, New Jersey

FINAL REPORT

EVALUATION OF FORWARD AREA ASSAULT PLANS FOR ARMY HELICOPTER OPERATIONS

PROJECT NO. 150-530-01V
REPORT NO. RD-65-17

Prepared by:

Donald O. Brown
Project Manager

Reviewed by:

H. F. Slattery
Chief, Simulation Section II

A. S. Hall, Jr.
Chief, Traffic and Procedures Branch

This report is approved for submission to the Director, Systems Research and Development Service. The conclusions and recommendations are those of the Evaluation Division. It does not necessarily reflect FAA policy in all respects and it does not, in itself, constitute a standard, specification, or regulation.

H. V. Hermansen
Acting Chief, Evaluation Division

February 1965

FEDERAL AVIATION AGENCY
SYSTEMS RESEARCH AND DEVELOPMENT SERVICE
Evaluation Division
National Aviation Facilities Experimental Center
Atlantic City, New Jersey

PROPRIETARY INFORMATION

The information contained herein is proprietary to the U. S. Army and shall not, without permission of the Director of Army Aviation, Assistant Chief of Staff for Force Development, Department of the Army, be used or duplicated by anyone.

TABLE OF CONTENTS

TABLE OF CONTENTS (CONTD)

TABLE OF CONTENTS (CONTD)

LIST OF ILLUSTRATIONS

ILLUSTRATIONS (CONT.)

LIST OF TABLES

Federal Aviation Agency, Systems Research and Development Service, Evaluation Division, Atlantic City, New Jersey.
EVALUATION OF FORWARD AREA ASSAULT PLANS FOR ARMY HELICOPTER OPERATIONS by Donald O. Brown, February 1965, 39 pp., incl. 19 illus., plus 8 appendices (71 pp.), Final Report.
(Project No. 150-530-01V, Report No. RD-65-17)

ABSTRACT

An evaluation of operational plans was conducted to provide the U. S. Army with procedures, separation values, basic navigation and air traffic control requirements for use in helicopter assault missions under instrument flight conditions. The evaluation consisted of dynamic simulation as well as live flight tests.

Live flight tests were conducted by the 11th Air Assault Division, Fort Benning, Georgia, with the assistance of Federal Aviation Agency project personnel to obtain information as to the ability of helicopter pilots to maintain an assigned airspeed, altitude, and track. Data from these tests were used as a partial basis for separation values which were applied to the plans tested in dynamic simulation.

Six operational plans for like and mixed-type helicopters resulted from the simulation. Each plan handled both normal and emergency situations and the movement rates established for each.

It was concluded that the procedures, separation values, and equipment requirements as described for each of the six operational plans are adequate for use in conducting helicopter assault missions under instrument conditions. It was further concluded that pilot and controller proficiency are important to the successful conduct of a mission.

It was recommended that these procedures, values, and requirements be considered for use by the U. S. Army and that further live tests be conducted by the Army under actual field conditions.

INTRODUCTION

Purpose

The purpose of this project was to evaluate operational plans in order to provide the U. S. Army with procedures, separation values, and basic navigation and air traffic control requirements for use in the conduct of helicopter assault missions under instrument flight conditions.

Background

In August of 1964, the Acting Director of Army Aviation requested the Systems Research and Development Service to aid the 11th Air Assault Division in exploring a concept of instrument flight by assault helicopters. This concept was developed by Major Chester R. Mead, U. S. Army.

Present operational procedures require that air assault missions be conducted under visual conditions. To exploit shock effect in forward areas of the battle zone, a maximum number of aircraft are employed in any given mission. Under visual flight conditions, flights are organized into two, three, and/or four ship formations, all landing simultaneously on the air assault area. Instrument flight conditions require other means of handling large volumes of traffic without degradation of shock effect.

In September 1964, discussions covering background information and the scope of the proposed project were held at the National Aviation Facilities Experimental Center (NAFEC), Atlantic City, New Jersey. The Evaluation Division Project Team and the U. S. Army Project Officer collaborated in developing a test program which would lend itself to gathering necessary information for application to the concept being studied.

As a result of these detailed discussions, project team members were to make graphic analyses of departure, enroute, and approach procedures for a tactical operation. In addition, live flight tests were to be made to provide project personnel with information as to the ability of helicopter pilots to maintain an assigned altitude, airspeed, and track. These live-tests were to be conducted by the Army with assistance from NAFEC project personnel. Data from these tests were to be used as a partial basis for separation values to be applied to the plans for dynamic simulation of the tactical operation plans.

DISCUSSION

General

This project was accomplished in three steps:

Step 1: The first step was the formulation of operational plans which would provide a means of moving helicopters under instrument conditions. Eight plans were developed by the project team using the army concept as the broad guideline. Each plan was devised to accommodate a specific number of helicopters and the eight plans were intended to provide the army with a selection to meet different needs. The concept dictated that the plans should be simple, flexible and adaptable to most field situations. The plans were based upon procedural, rather than radar separation, and the tentative separation values used were less than the FAA standards. These separation values were believed to be a logical starting point for further investigation. The major ground rules used in the development of the plans were:

1. Missions would be within a radius of 50 nautical miles.

2. Minimum separation between aircraft and minimum terrain clearance would be employed.

3. Weather conditions would be a ceiling of 200 feet and visibility one-fourth mile. Helicopters were considered to be in visual flight conditions below 200 feet with one-fourth mile visibility.

4. Nondirectional radio beacons would be used for track guidance.

5. Communications and traffic control actions would be kept to a minimum.

6. Crew requirements included a co-pilot.

Step 2: This step consisted of live flight tests to obtain pilot performance data which could be used as a partial basis for arriving at separation values, determining movement rates of each plan, and traffic control techniques. Data were collected with regard to pilot's ability to maintain airspeed, altitude and track. In addition, flight tests were conducted to establish rates of climb and descent and airspeeds to be used in the departure and approach procedures. Tests of multiple departures and approaches were also made to observe their application and to obtain pilot opinions.

Step 3: This step was planned to examine each plan under dynamic simulation. As each plan was run, modifications were made to the procedures and the best features of the plans were consolidated to arrive at basic plans for moving different rates of helicopters. In addition, the separation values were examined and modified as related to the air traffic control techniques used with each plan and air traffic controller requirements were verified.

Live Flight Tests

Environment: The live-tests were conducted at Fort Benning, Georgia, using Bell UH-1B Helicopters (FIG. 1). An ADF receiver and Radio Magnetic Compass Indicator were the only airborne equipment used for navigation purposes.

The Columbus, Georgia (CSG) "H" type nondirectional radio beacon served as the primary navigation aid for the track flown. A portable type nondirectional radiobeacon of approximately 20 watts power was used at the destination point of the track flown. This equipment was a battery-powered, low output-type navigation aid, specifically designed for a tactical operation.

Eight U. S. Army Aviators from the Third Aviation Company, 11th Air Assault Division, participated in the tests. All were instrument rated in helicopters and individual flying experience in helicopters ranged from approximately 500 hours to approximately 2000 hours. Most of the pilots also had fixed wing aircraft flight time.

Test Procedures: Live flight tests were conducted in three phases. Phase I was designed to determine pilot performance in flying an assigned airspeed, altitude, and track. Twenty-four flights over a prescribed course were completed.

To simulate instrument flying conditions, the bubble or windshield on the pilot side of the cockpit was covered and the pilot was hooded. For the purpose of these tests, procedures were used which would be comparable to those for a tactical operation. The pilot was furnished a small map which indicated heading, altitude, and distance of the route to be flown (FIG. 2).

The safety pilot, in addition to his regular duties, recorded track information on a map overlay which was placed over an aeronautical map of the area (FIG. 3). A data collector, stationed behind and between the pilot and safety pilot, recorded observations of indicated altitude and airspeed every 30 seconds. Data collection commenced at the time of passing the CSG nondirectional radio beacon and continued until arrival

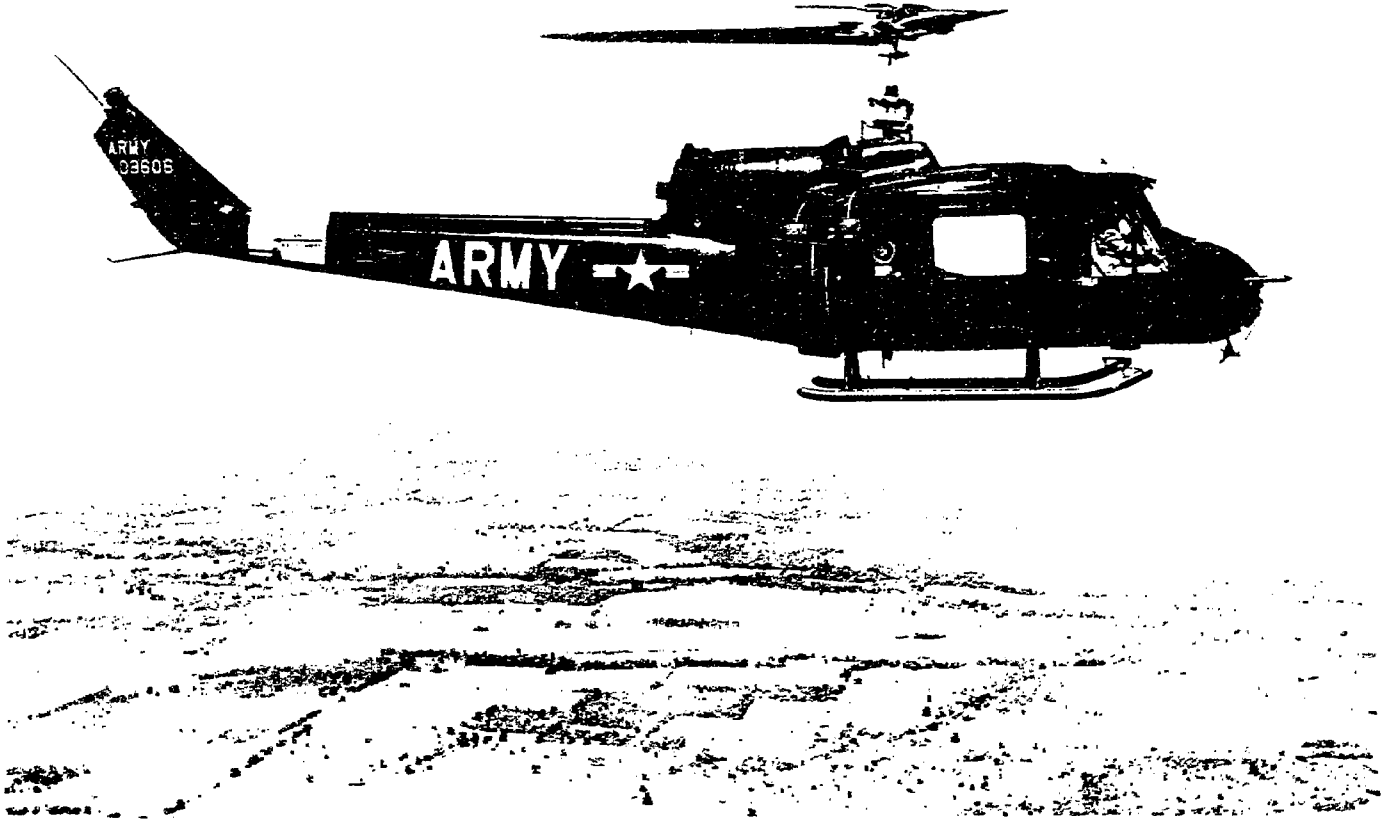


FIG. 1 U. S. ARMY UH-1B IROQUOIS

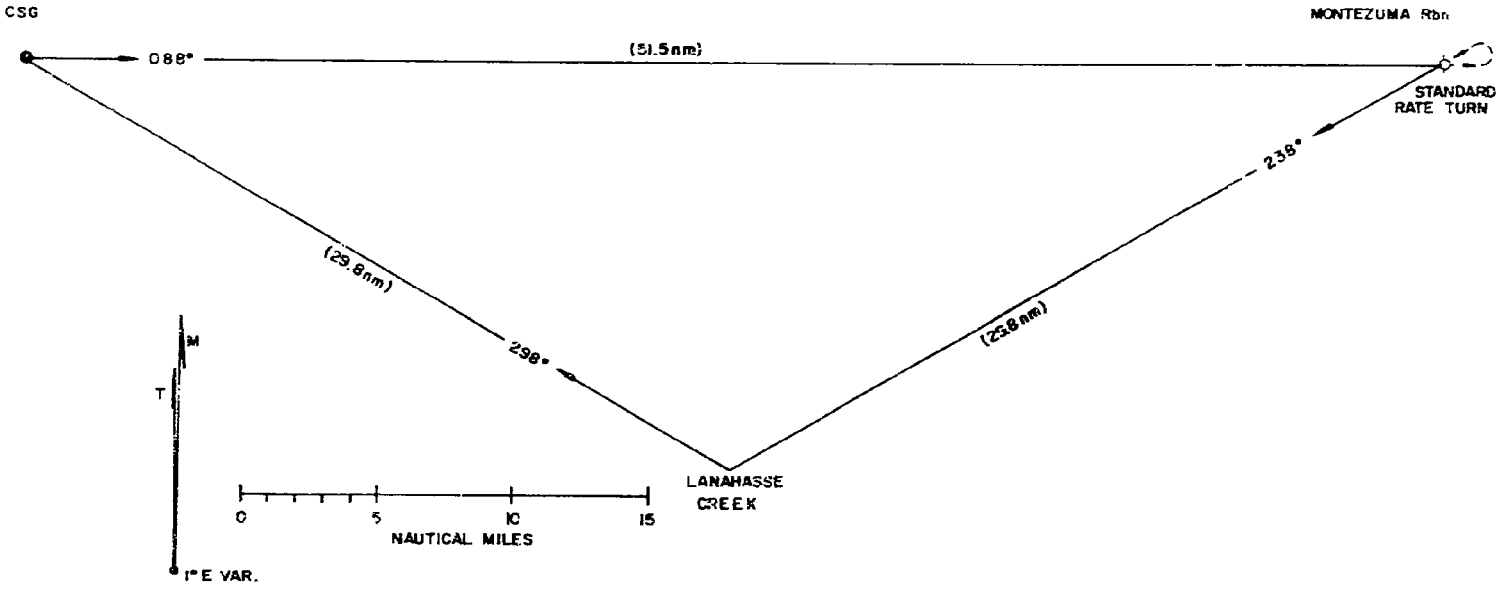


FIG. 2 LIVE-TEST FLIGHT ROUTE

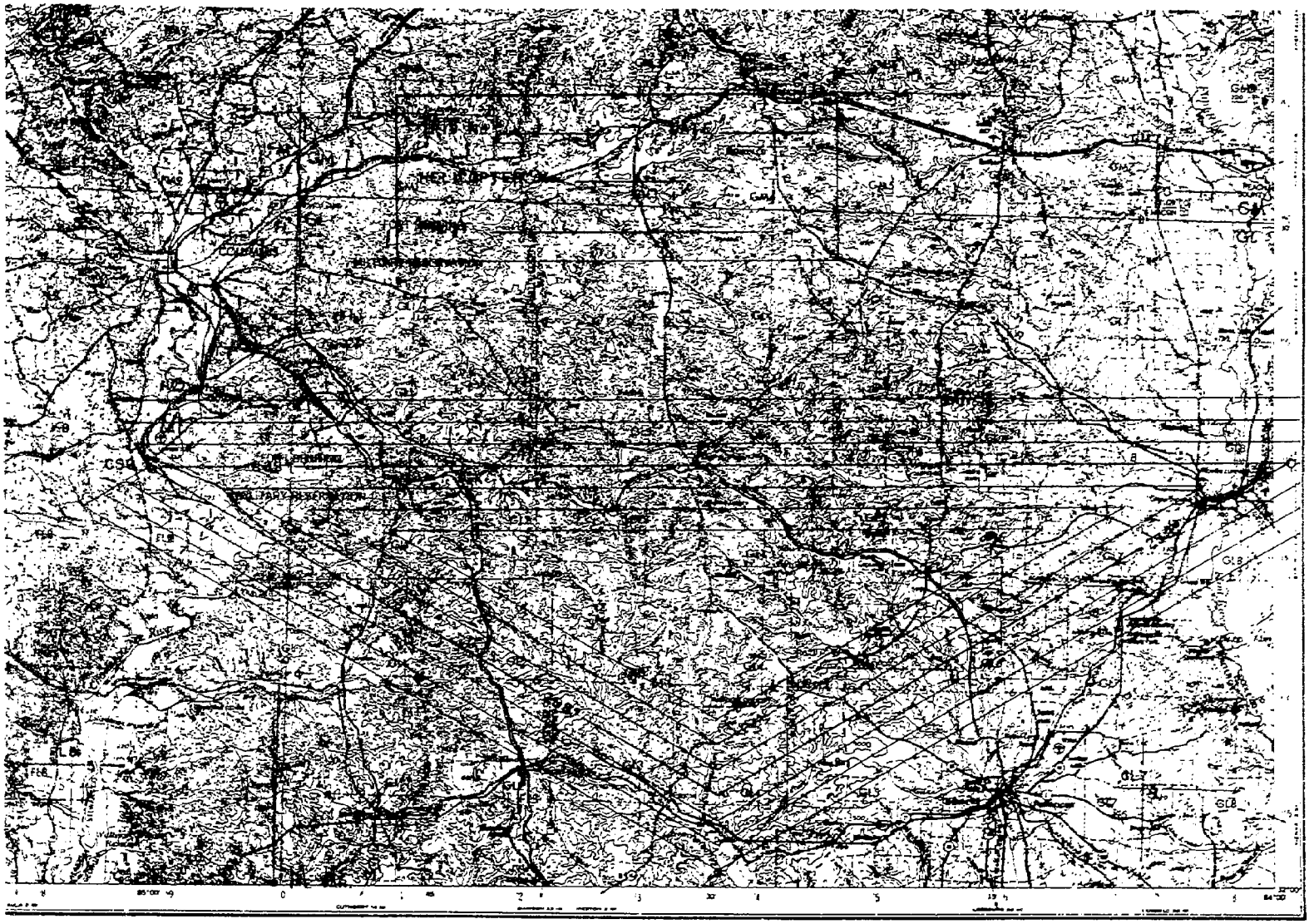


FIG. 3 AERONAUTICAL MAP AND MAP OVERLAY

over the portable nondirectional radio beacon located on the Montezuma Airport. Upon completion of a left turn beyond the radio beacon at Montezuma, the data collection was resumed and continued until arrival over the CSG radio beacon.

The test was planned so as to collect data at four flight levels. The first assigned altitude was 400 feet above the highest obstruction or terrain along the route with the higher altitudes assigned at each succeeding 500 foot level. In this manner a sampling of altitudes was available at 900 feet MSL, 1400 feet MSL, 1900 feet MSL, and 2400 feet MSL.

Phase II was to determine an optimum airspeed and rate of descent during instrument approaches. The current speed of 80 knots and 500 FPM rate of descent caused the approach flight path to be extended an excessive distance beyond the approach fix.

A study was made of the height velocity diagram (FIG. 4) appearing in the flight operating handbooks for the UH-1A and UH-1B Helicopters. Based on this study, speeds of 40, 50, and 60 knots with descent rates of 400, 500, and 800 FPM were selected to be investigated for both an empty and loaded helicopter. The approach would be started at an altitude that would afford a minimum of 1000 feet of descent, terminating at an altitude of 200 feet above the ground. The first approaches were made with a gross weight of approximately 6,326 pounds with a density altitude of 2000 feet. The second series of approaches were made with a helicopter weighing approximately 7,026 pounds with a density altitude of 2600 feet. The terrain selected for the test was an open area 500 feet above mean sea level.

Phase III of the live flight tests was conducted to gather pilot opinion on the feasibility of multiple approach and departure procedures. It consisted of flight tests of departure and approach procedures, during which the pilots were not hooded. The pilots practiced the procedures prior to the actual tests. The departure and approach procedures employed are shown in Figures 5 and 6. Five helicopters took off at one-minute intervals, climbed to different assigned altitudes, proceeded beyond the CSG radio beacon on an assigned track for a specified period of time, reversed course to CSG, and completed a penetration and return to the CSG radio beacon. After arrival at low altitude over CSG the helicopters proceeded to Lawson Field and landed. In a tactical situation a landing would have been accomplished on the assault base. This test was conducted three times.

The pilots alternated in flying the trips. Flight plans were furnished showing only the procedure to be followed by the pilot of that particular aircraft. The handout flight plan indicated the sequence of takeoff, altitude, headings, rate of climb, speed in climb, cruise speed,

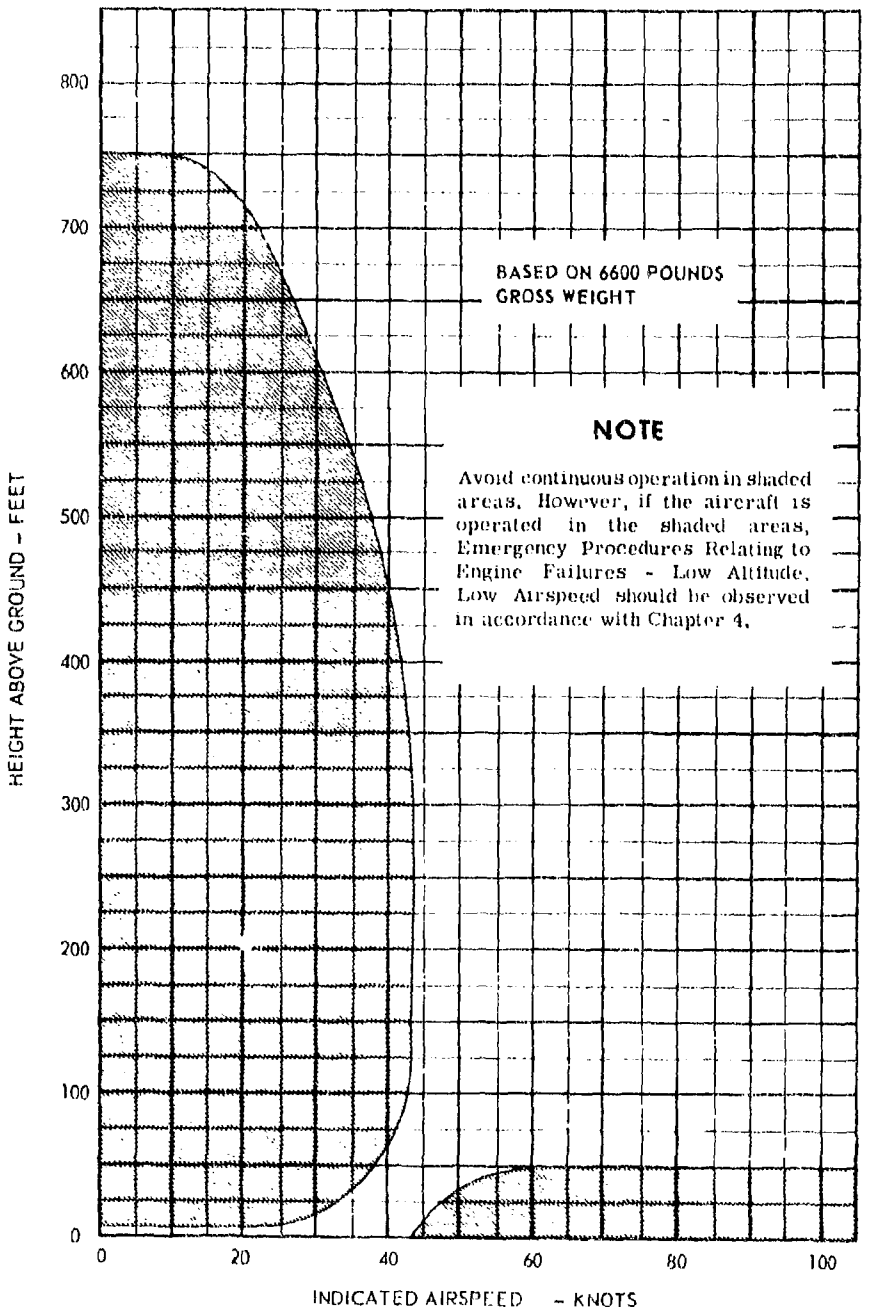


FIG. 4 HEIGHT VELOCITY DIAGRAM FROM HANDBOOKS FOR ARMY MODELS UH-1A AND UH-1B HELICOPTERS

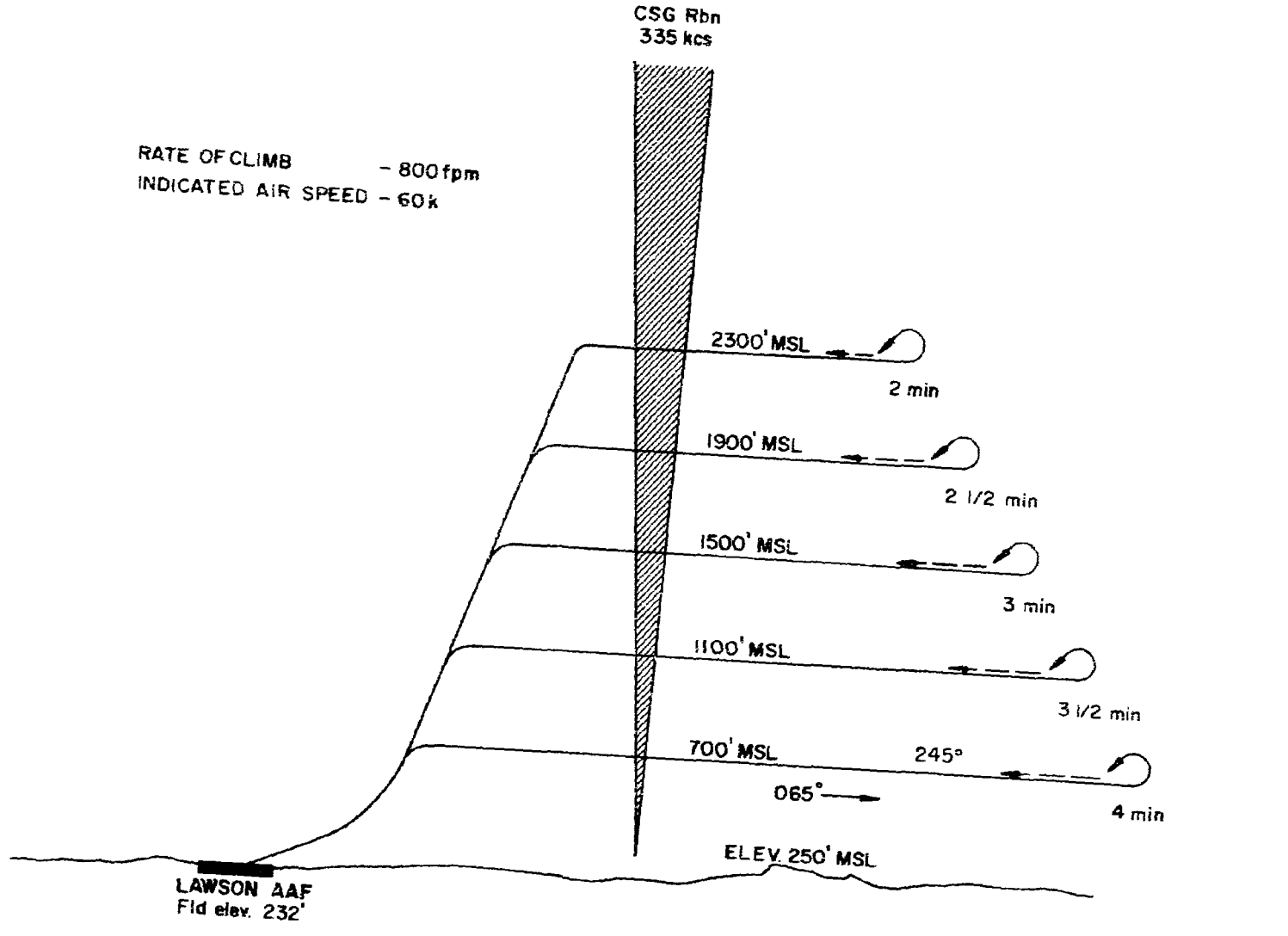
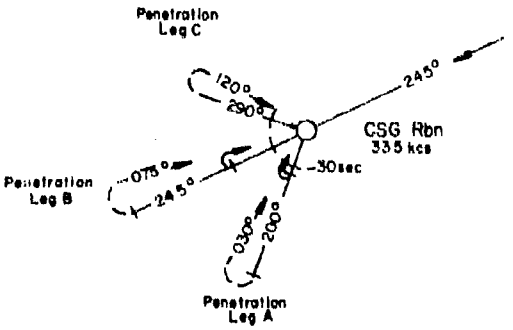
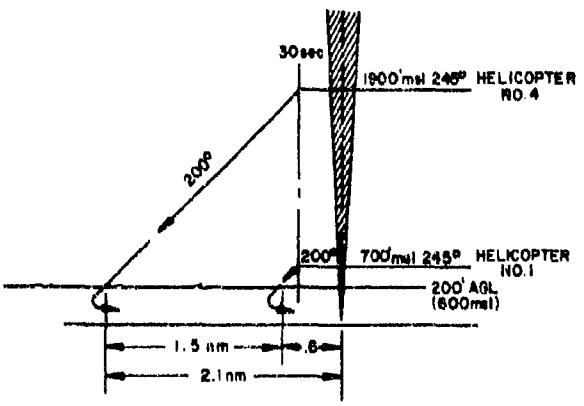


FIG. 5 DEPARTURE PROCEDURE (LIVE-TEST)

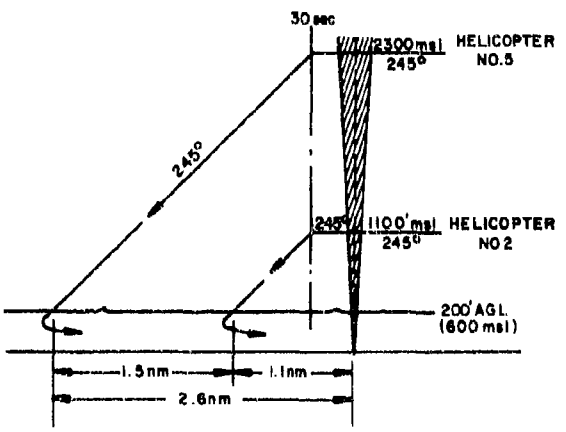


RATE OF DESCENT – 800fpm
INDICATED AIR SPEED- 60k.

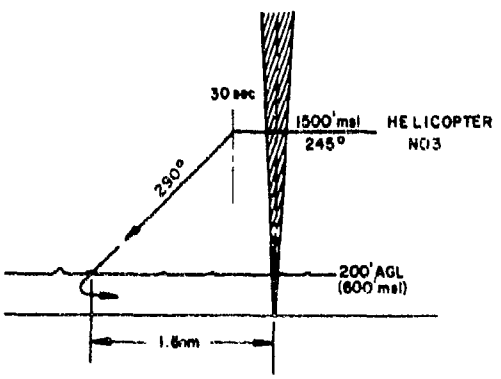
PENETRATION LEG A



PENETRATION LEG B



PENETRATION LEG C



HELICOPTER	DESCENT	TIME	DISTANCE
NO. 1	100'	00:37.5	0.6nm
NO.2	500'	01:07.5	1.1nm
NO.3	900'	01:37.5	1.6nm
NO.4	1300'	02:07.5	2.1nm
NO.5	1700'	02:37.5	2.6nm

FIG. 6 APPROACH PROCEDURE (LIVE-TEST)

and descent rate and speed.

Live Test Results: During the Phase I data collection period, official U. S. Weather Bureau sequence observations were recorded. No extreme weather conditions were experienced during these flights and within the range of conditions shown in these reports, normal flying weather existed.

Reduction of the airspeed and altitude data collected at 3,799 data points during this period was accomplished by means of a computer program. In the case of airspeed, the program compared at each 30-second interval the observed airspeed with the assigned airspeed, computed the differences, and calculated the mean and standard deviation of the differences. The program also performed a comparison of the observed and assigned altitudes at the successive 30-second intervals, computed the differences, and calculated the mean and standard deviation of these differences.

The mean and standard deviation of the differences computed for airspeed and altitude are shown in Table I. This table also cites the maximum positive and negative deviations found to exist in each case.

TABLE I

STATISTICAL RESULTS OF PHASE I TESTS

	Mean Difference	Standard Deviation	Maximum Deviations	
Airspeed (knots)	-0.35	$\pm$ 3.08	+16	-12
Altitude (feet)	+7.06	$\pm$30.65	+250	-120

In addition, the Department of the Army Technical Manuals for the Models UH-1A, UH-1B, and UH-1D Helicopters; the FAA Flight Manual for the Bell Model 204B (Commercial version of the Military UH-1), data from the Bell Helicopter Company, and applicable Federal Air Regulations, were searched in an attempt to determine an appropriate allowance for airspeed and altimeter system error. The referenced material did not provide the information required to numerically express a total allowance for error in the airspeed and altimeter systems of the UH-1 Helicopters. In lieu of numerical values, buffer airspace was used to make allowance for the lack of system error data.

To arrive at a longitudinal separation value, several sources of errors were considered. These were, pilot deviation from assigned

airspeed, airspeed system error, and deviations from the desired flight path.

Figures 7, 8, 9, 10, and 11, depict the manually recorded history of tracking for each helicopter flight. It must be pointed out that reception of the portable nondirectional radio beacon installed at the Montezuma Airport was, in many instances, unsatisfactory at the desired distances. This fact, plus an occasional malfunction of navigation equipment in the helicopters, accounted for most of the extreme deviations. The tracking associated with the CSG radio beacon permitted an evaluation of pilot performance in ADF operations. Track information, as shown in the referenced figures, did not suggest any reduction from the FAA standards of 45 degree divergence between inbound and outbound tracks. However, there was reasonable indication that air route width could be considered as extending a distance of three nautical miles either side of the direct route.

During the test period, there was only one instance where a maximum difference of four minutes occurred between the earliest and latest arrival over the destination beacon. This difference was a result of the relative cumulative errors of pilot deviations from assigned airspeed, airspeed system errors and track deviations over a 51.5 nautical mile straight course. Since pilot's mean deviation from assigned airspeed would result in negligible differences of arrival time at destination (approximately 10 seconds) airspeed system error and track deviations were the more important factors to be considered. In view of the above and the limited time available to fly the prescribed course, and malfunctions of navigation equipment, a five-minute longitudinal separation for helicopters cruising at 80 knots was deemed reasonable. Additional live flight tests would be required to validate this assumption. The test results emphasized the need for reliable navigation aids and a high degree of pilot proficiency.

If a mean value of actual point-to-point elapsed times from point A to B were known, it is possible to set up longitudinal separation values to reduce the risk of overtake to any predetermined value on a calculated risk basis. This may be accomplished by practical application of the principle as described in FAA Technical Development Report No. 410, entitled "The Use of Simulation in ATC Systems Engineering" dated April 1959. This statistical approach is illustrated graphically in Figure 12. The known mean value of actual time for route segments flown in the live-tests at Fort Benning was not conclusive because of the above mentioned problems. Further and more comprehensive live-tests can supply the quantitative and qualitative data required for application of this principle.

The maximum positive deviation (by one pilot) of 250 feet from assigned altitude noted in Table I occurred only one time out of 3,799 observations. The maximum positive error among the other pilots was 140 feet. Deviations

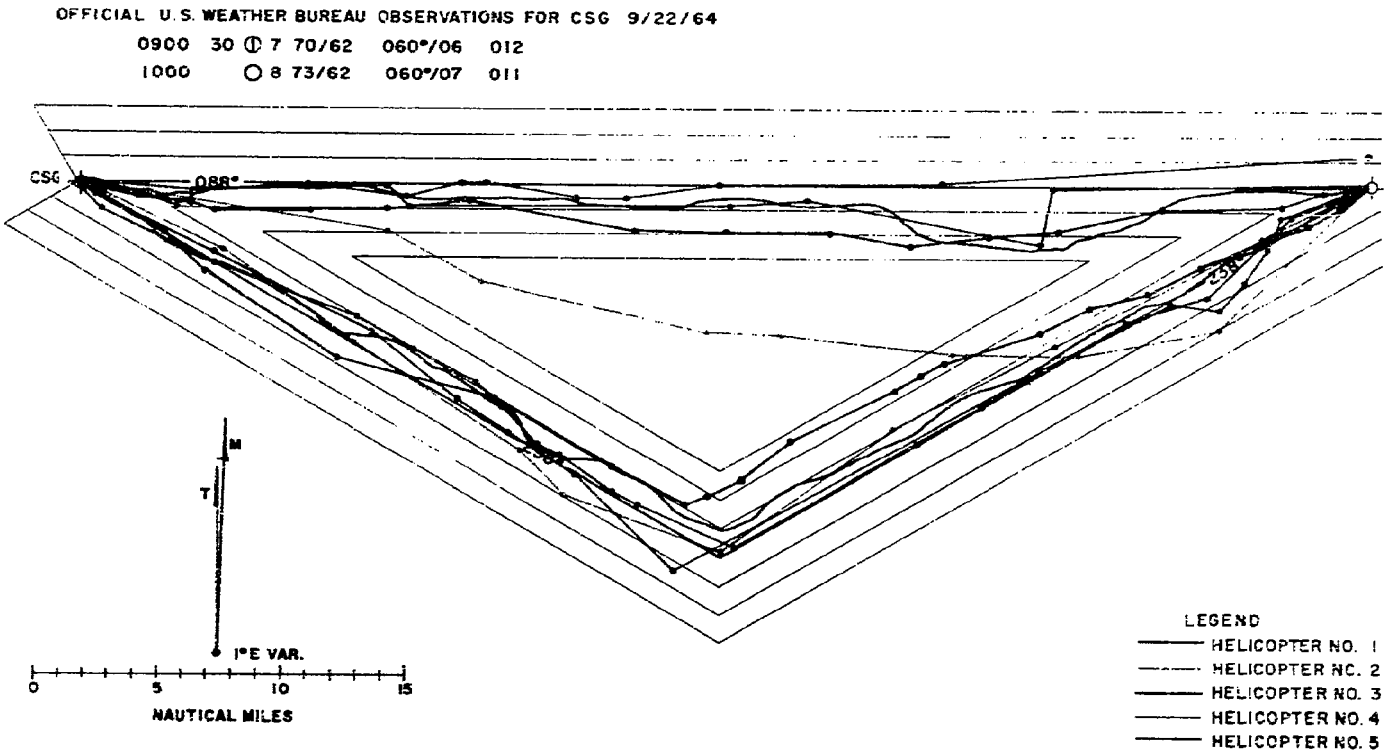


FIG. 7 PLOT OF TRACK DEVIATIONS - FLIGHT I

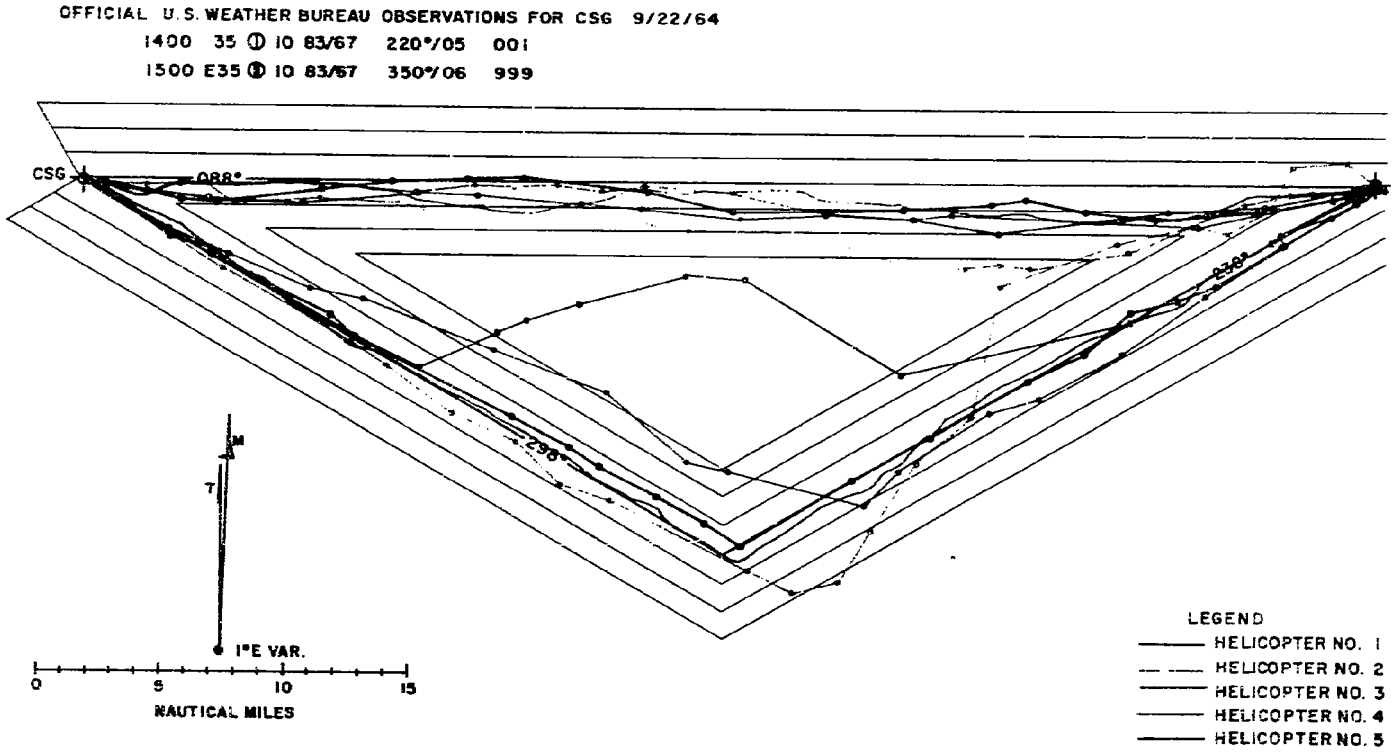


FIG. 8 PLOT OF TRACK DEVIATIONS - FLIGHT II

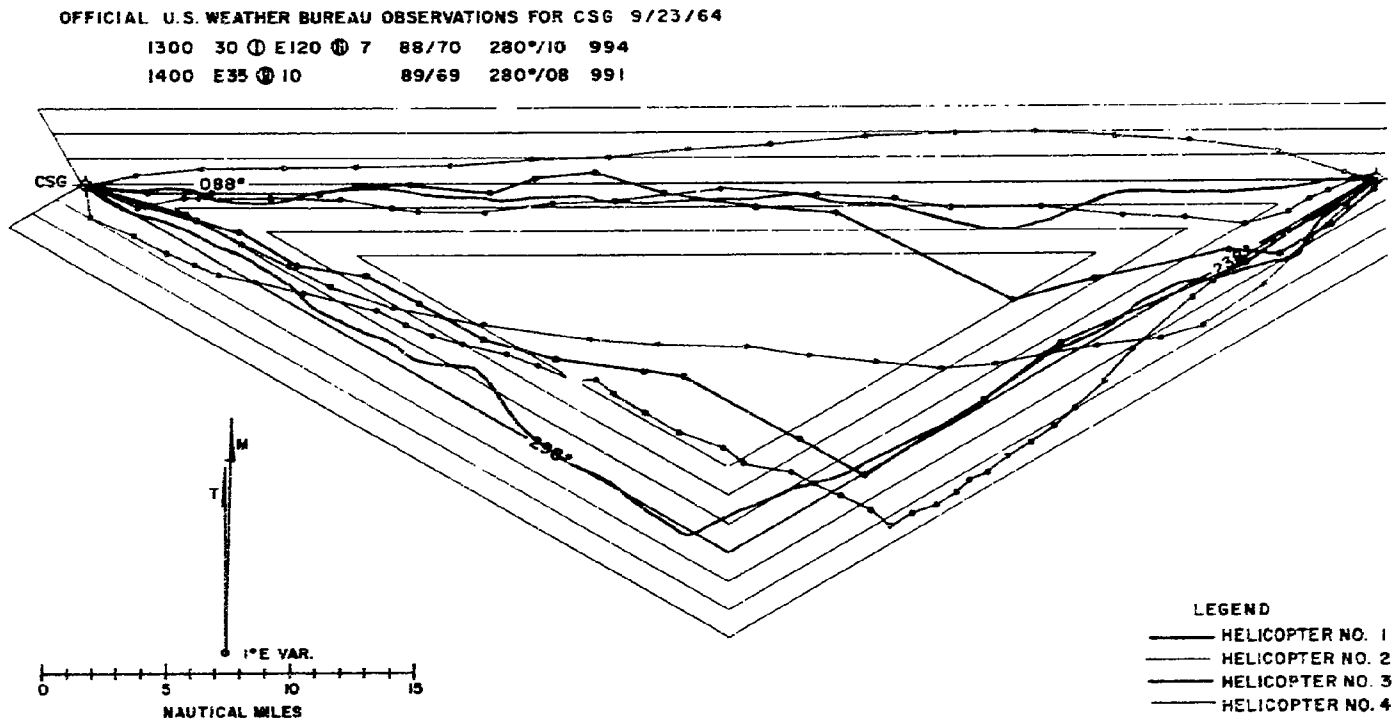


FIG. 9 PLOT OF TRACK DEVIATIONS - FLIGHT III

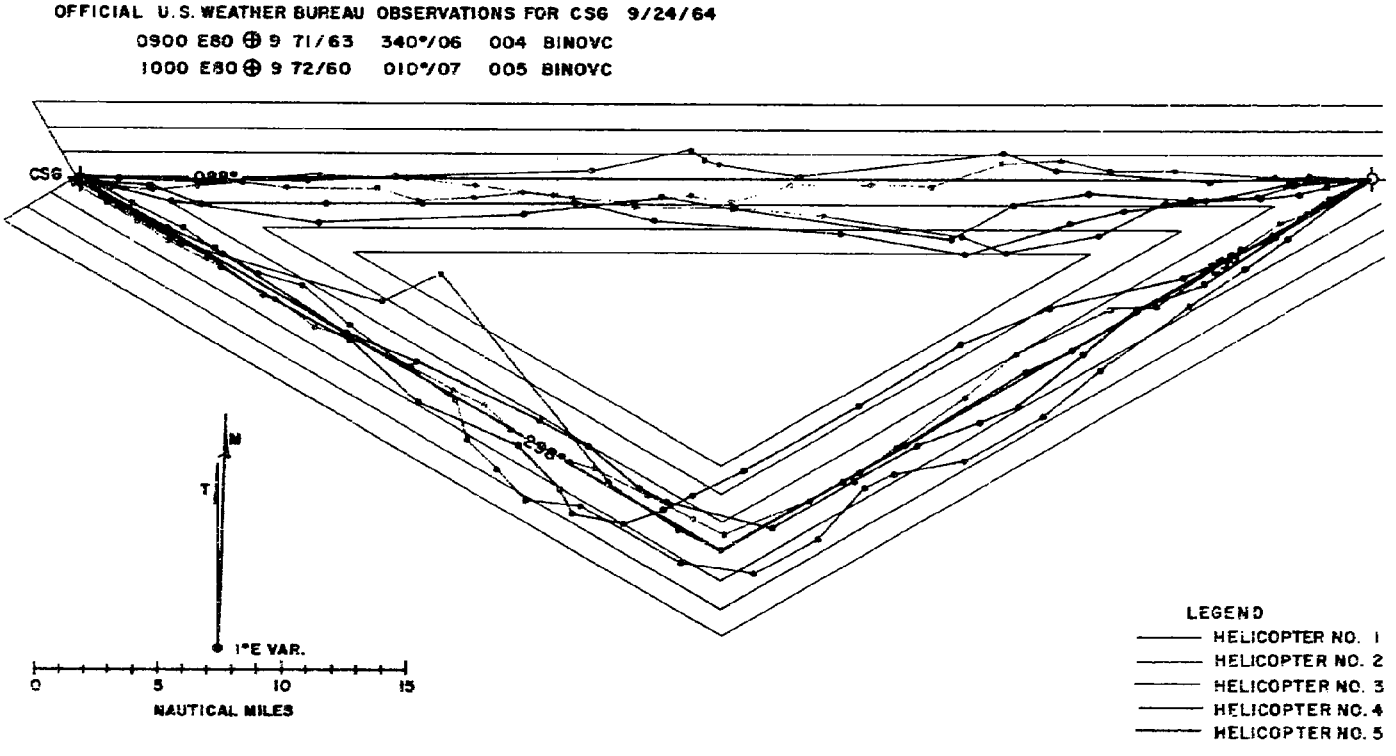


FIG. 10 PLOT OF TRACK DEVIATIONS - FLIGHT IV

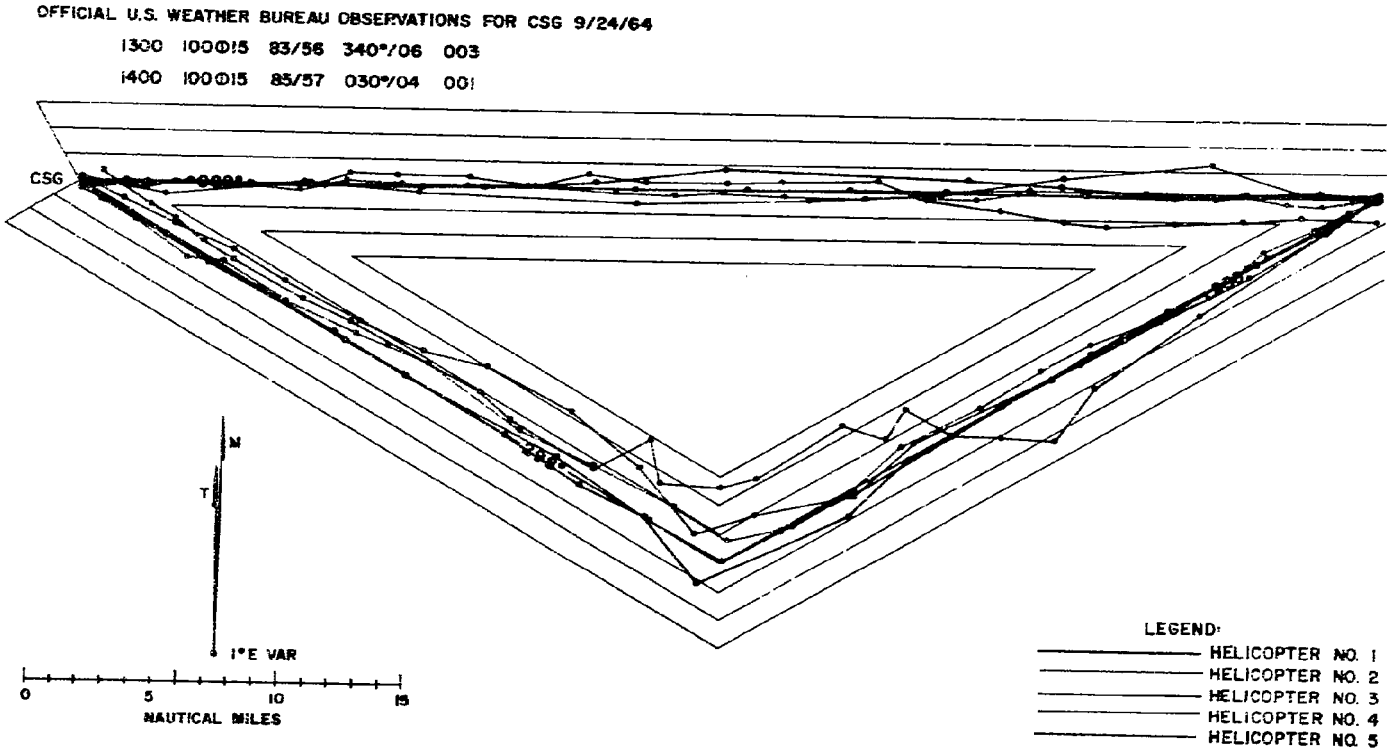


FIG. 11 PLOT OF TRACK DEVIATIONS - FLIGHT V

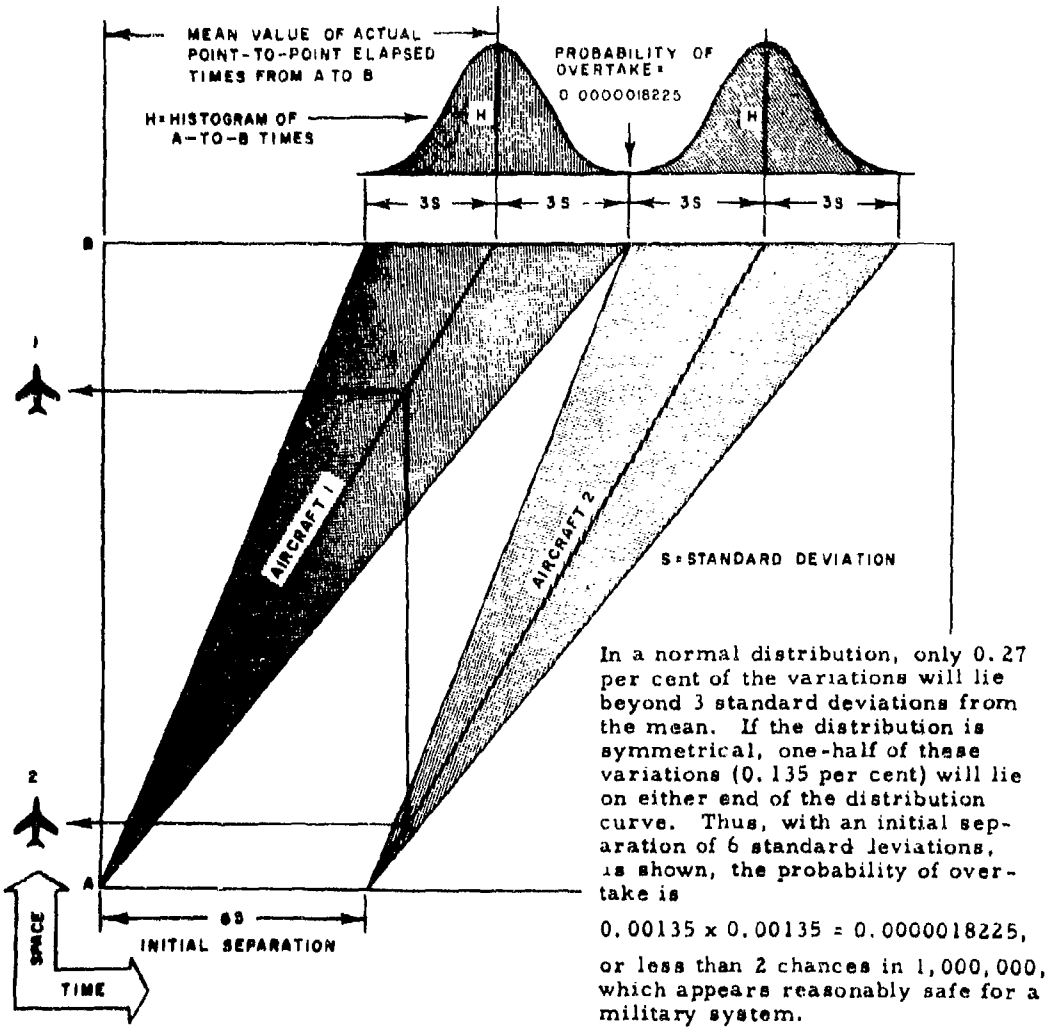


FIG. 12 SPACE-TIME CURVE ILLUSTRATING POSSIBLE STATISTICAL APPROACH TO DETERMINATION OF LONGITUDINAL SEPARATION STANDARDS

between 100 and 140 feet above assigned altitude by the seven other pilots occurred 18 times out of 3,480 observations.

A buffer area of vertical airspace was used to allow for total error in the helicopter altimeter system. Consideration was also given to vertical position error resulting from human actions. This error can begin at the point of pressure determination and accumulate through pilot adjustment of the sensitive altimeter. In the process of considering a total buffer allowance, the minimum vertical separation between helicopters was established at 400 feet. It is possible that limited meteorological facilities in a combat area would justify an increase of the vertical buffer area or the use of other procedures for attaining proper altimeter settings.

The separation values for longitudinal, vertical, track divergence, and route width may be subject to adjustment, as necessary, based on additional information and U. S. Army tactical requirements.

Observations of pilot performance during Phase II tests are shown in Tables II and III.

When approaches were attempted at 40 knots the aircraft had a tendency to yaw excessively, required abrupt heading and attitude changes and there was an inability to level off at the desired altitude.

At 50 knots with rates of descent of 800, 500, and 400 FPM , the results obtained were satisfactory in controlability of the aircraft in airspeed, rate of descent, heading and attitude control; but, according to the pilot, created an excessive workload due to control response lag resulting in either under or over controlling of the helicopter during corrections. Of the three rates of descent tried, the aircraft response was better at 800 FPM.

No difficulties were encountered in the 60 knot airspeed approach at 400, 500, 800, and 1000 FPM rates of descent. Approaches in all modes were completely satisfactory. The control response was instantaneous and the pilot workload was at a minimum.

After the approach tests, a debriefing was held with the pilots, the U. S. Army Project Officer, and NAFEC project personnel in attendance. The results of the approach investigation were discussed and it was agreed that an approach airspeed of 60 knots and a rate of descent of 800 FPM would be utilized in further tests and for the simulation. Further and more comprehensive tests would validate or revise these findings for operational use.

TABLE II

APPROACH SERIES NO. 1 - GROSS WEIGHT 6,326 LBS.

APCH NO.	ASSIGNED AIRSPEED (KNOTS)	DEVIATION FROM ASSIGNED AIRSPEED (KNOTS)	ASSIGNED RATE OF DESCENT (FPM)	DEVIATION FROM ASSIGNED RATE OF DESCENT (FEET)	INITIAL ALTITUDE (MSL)	LEVEL-OFF ALTITUDE (MSL)	LOSS OF ALTITUDE DURING LEVEL-OFF (FEET)	ASSIGNED HEADING (DEGREES)	DEVIATION FROM ASSIGNED HEADING (DEGREES)	PILOT REMARKS
1	60	± 10	800	± 50	1700	700	30	360	± 5	
2	50	± 10	800	± 50	1700	700	0	315	± 20	
3	50	± 3	800	0	1700	700	0	045	0	Good
4	40	- 15	400	± 10	1700	700	10	045	± 10	
5	40	- 15	400	+100	1700	700	25	315	± 10	
6	60	± 5	400	+100	1700	700	0	045	± 6	Good
7	60	± 5	400	±100	1700	700	0	360	± 6	
8	50	± 3	800	± 70	1700	700	20	045	± 3	
9	40	- 15	800	± 50	1700	700	40	360	± 15	Poor
10	60	± 5	800	±100	1700	700	0	315	± 3	
11	50	± 5	400	+200	1700	700	20	045	± 4	

TABLE III

APPROACH SERIES NO. 2 - GROSS WEIGHT 7,026 LBS.

APCH NO.	ASSIGNED AIRSPEED (KNOTS)	DEVIATION FROM ASSIGNED AIRSPEED (KNOTS)	ASSIGNED RATE OF DESCENT (FPM)	DEVIATION FROM ASSIGNED RATE OF DESCENT (FEET)	INITIAL ALTITUDE (MSL)	LEVEL-OFF ALTITUDE (MSL)	LOSS OF ALTITUDE DURING LEVEL-OFF (FEET)	ASSIGNED HEADING (DEGREES)	DEVIATION FROM ASSIGNED HEADING (DEGREES)	PILOT REMARKS
1	60	± 5	800	± 200	2300	700	30	360	± 4	
2	50	± 3	800	± 100	2300	700	25	315	± 5	
3	40	- 15	800	- 300	2300	700	25	045	± 30	Not So Good
4	40	- 15	500	± 200	2300	700	25	045	± 15	
5	50	± 3	500	± 200	2300	700	25	315	± 10	
6	60	± 3	500	± 100	2300	700	0	045	± 5	
7	60	± 3	800	± 100	2300	700	15	360	± 5	Very Good
8	60	± 3	800	± 100	2300	700	0	045	± 7	Very Good
9	60	± 3	1000	± 150	2300	700	15	360	± 7	

During Phase III, three flights with five helicopters in each flight were completed. The multiple approaches were performed under rigidly controlled conditions. A critique after this phase revealed no adverse opinions; however, it was agreed that further investigations would be required to determine the effects of arrival time errors and displacement of helicopters about the arrival fix.

Dynamic Simulation Tests

General: A dynamic simulation was programmed to investigate problem areas and permit observation, refinement, and objective evaluation of each plan. Eight plans were formulated prior to the start of dynamic simulation. Four of these plans were for like-type helicopter operations and four permitted a mixed-type helicopter operation. The theoretical arrival rate at the assault base of each plan was determined by the number of altitudes, the configuration and number of navigation aids, and the assignment of like or mixed-type helicopters to discrete altitudes. The parameters for simulation were based on separation values which used, as a partial basis, the results of information gained in the live-test operation. The plans were subjected to dynamic testing and modification during November 1964. During the tests, one of the plans, in which two nondirectional radio beacons were used at the fixed base, was determined to be unacceptable and the plan was rejected. A new plan, using two nondirectional beacons at the fixed base, was developed and tested, making a total of nine plans tested. Upon completion of the simulation, during which the plans were refined, modified, and combined, six operational plans were arrived at, documented, and are included as Appendices I through VI.

Environment: The Model A Dynamic Simulator (Appendix VII), consisting of 48 radar target generators or pilot consoles and associated radar displays, was used for this simulation. Each of these target generators produced a moving target at rates of speed comparable to the performance of the helicopters considered in these tests.

Provision was made to include the performance characteristics of the Bell UH-1B Iroquois (FIG. 1) and the Boeing CH-47A Chinook (FIG. 13). A cruise speed of 110 knots was used for the Chinook. Climb and descent was at 70 knots and 1000 FPM. Climb and descent rate of the Bell Iroquois was simulated at 60 knots and 800 FPM and a cruise speed of 80 knots.

A discrete radio communication channel was assigned to the fixed and assault bases and a point-to-point voice channel was assumed to exist between the two bases.

FIG. 13 U. S. ARMY CH-47A CHINOOK

A hypothetical area was used for simulation with a distance of 27.4 nautical miles between the nondirectional radio beacons at the fixed base and the assault base. In those tests employing a single nondirectional radio beacon at each base, the two-letter identification "SL" was assigned to the fixed base and "OB" to the assault base. In some of the tests, two nondirectional radio beacons arbitrarily located three miles apart were used at the fixed base. In those tests where two nondirectional radio beacons were used at the fixed base, identifications of "DB" and "JH" were assigned at the fixed base and "MA" was assigned at the assault base.

Air Traffic Controllers: Five air traffic control specialists (ATCS) participated in the dynamic simulation tests. Two of these controllers were from NAFEC and in addition to their qualifications as air traffic controllers, both were rated pilots, one of whom was also helicopter rated. The other three were from the 11th Air Assault Division, Fort Benning, Georgia assigned to the project for a short familiarization period. Two controllers, one at the fixed base and one at the assault base, were used for testing the plans. Critiques were held frequently during the simulation and questionnaires (Appendix VIII) were completed by the controllers at the conclusion of the simulation.

Separation Values:

Departure Separation - A minimum interval of one minute was used between successive departures where like-type helicopters departed and climbed at the same speed and rate of climb through the altitude of a preceding departure.

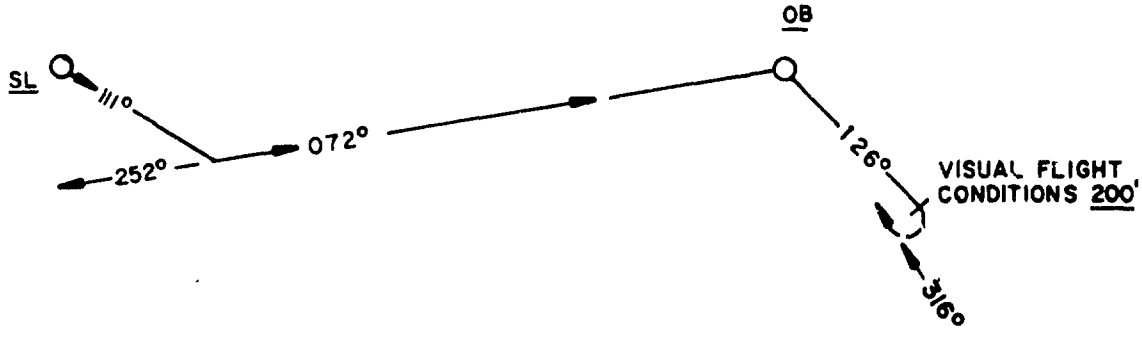
Track Separation - A divergence of 30 degrees was used between aircraft on two departure tracks. A divergence of 45 degrees was used between aircraft on inbound and outbound tracks, with a restriction placed on traffic on the departure track until reaching the boundary of the inbound route.

Longitudinal Separation - Longitudinal separation at the same altitude was established at five minutes between UH-1 Helicopters. Between CH-47A Helicopters, longitudinal separation was established at four minutes. At the speed of 110 knots, the four minutes separation between CH-47A Helicopters provided a greater separation in miles than did five minutes separation for UH-1 Helicopters at a speed of 80 knots.

Vertical Separation - Four hundred feet was established as the minimum obstruction clearance altitude, and as the vertical separation between helicopters.

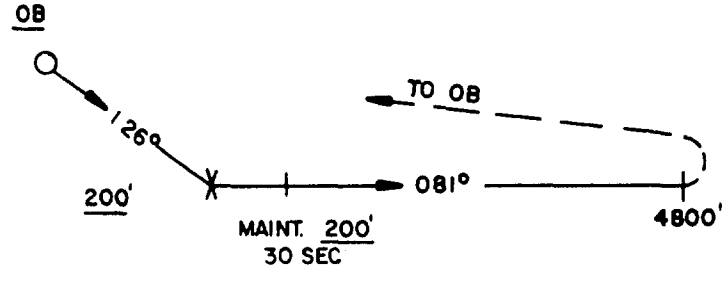
DEPARTURE FROM FIXED BASE PLAN IIB

D-35 Track 111° from the SL Rbn, climb to and maintain 2400 feet. Maintain track of 111° until intercepting a bearing of 252° from the OB Rbn. Track 072° to the OB Rbn. Track 126° from the OB Rbn, maintain 2400 feet for 30 seconds, then descend to Visual Flight Conditions (200 feet). Upon reaching Visual Flight Conditions, turn right to intercept a track of 316° to the Assault Base Rbn.



MISSED APPROACH PROCEDURE

Turn left to a heading of 081°, maintain 200 feet for 30 seconds, then climb to 4800 feet. Upon reaching 4800 feet, turn left, proceed direct to the OB Rbn. Proceed as directed by the OB Controller.



Contact the OB Controller.
Give Acft Ident, heading, and
Alt. to which you are climbing.

FIG. 14 SAMPLE OF DEPARTURE CLEARANCE FROM FIXED BASE

EMERGENCY RETURN PROCEDURE PLAN IIB

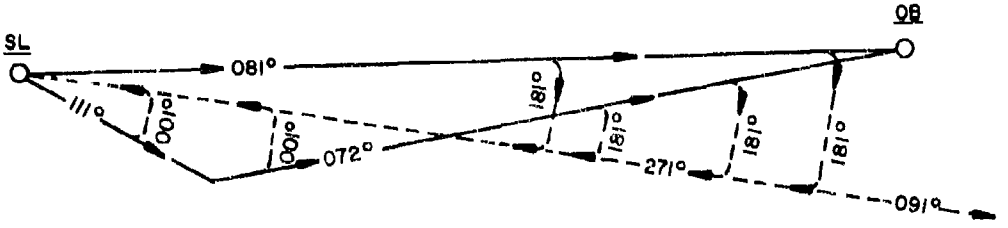
Intercept 091° bearing from SL Rbn. Track 271° to the SL Rbn. Maintain assigned altitude.

Aircraft South of 091° Bearing from SL Rbn.

Turn left heading 001° to intercept.

Aircraft North of 091° Bearing from SL Rbn.

Turn right heading 181° to intercept.



Upon passing the SL Rbn, track on the heading according to the chart below as dictated by your altitude. Maintain assigned altitude for 30 seconds, then descend to Visual Flight Conditions (200 feet). Upon reaching Visual Flight Conditions, turn right and proceed to the Fixed Base.

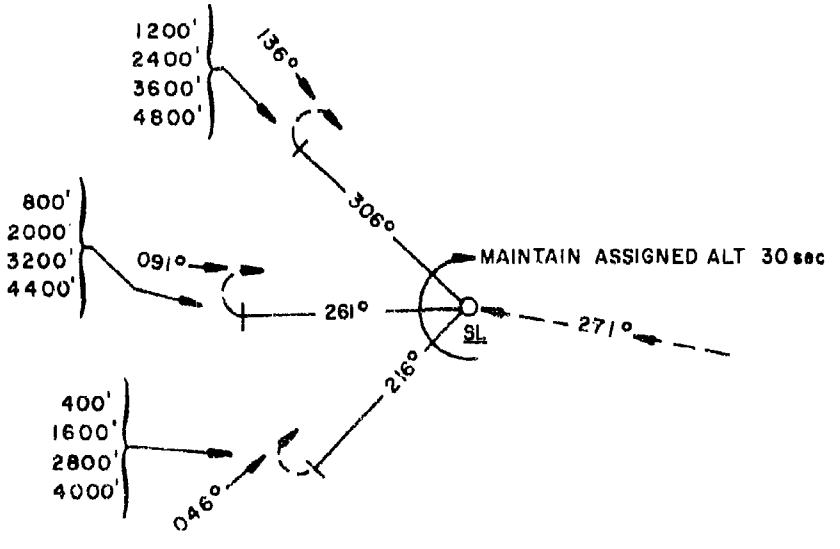


FIG. 15 SAMPLE OF EMERGENCY RETURN PROCEDURE

Operational Procedures:

General - Figure 14 shows a sample pilot handout for a departure clearance from the fixed base. Departure, enroute, approach, and missed approach information was included on the front side of the handout departure clearance. The reverse side described the emergency return procedures (FIG. 15). The CH-47A Helicopters were assigned a discrete departure route and departed simultaneously with UH-1 Helicopters on a track which diverged by at least 30 degrees. Departure control charts indicating departure time, aircraft identification, aircraft type, clearance, and altitude, were prepared prior to the mission and were used in the dispatch of the aircraft from the fixed base. A departure control chart for the fixed base is included as an illustration for each of the plans.

Departures from the assault base were assigned a visual flight condition restriction at or below 200 feet above ground level, on a diverging track of at least 45 degrees, until reaching the boundary of the inbound route. In most of the plans this was a distance of five miles, which was converted to time based on the speed of the helicopter. At the expiration time of the visual flight condition restriction, the pilot commenced climb, maintaining the diverging track until reaching an altitude 100 feet above the altitude of the highest inbound traffic. At that time a turn was made direct to the fixed base radio beacon. In two of the plans the diverging track for departure from the assault base was maintained until intercepting a track to the fixed base radio beacon. Figure 16 shows a sample of a departure clearance from assault base. Departure from assault base, enroute, and approach to fixed base procedures were included. The pilot would have in the aircraft a return clearance for each altitude, and merely select the one assigned. The departure control chart for use at the assault base serves as a guide for assignment of return clearances. Since the departure sequence from assault base cannot be predicted, this chart gives only the clearance and the altitude which is associated with that clearance. It was the assault base controller's responsibility when assigning these clearances to adjust departure times to assure longitudinal separation between aircraft at the same altitude. A departure control chart for the assault base is included as an illustration for each of the plans.

Penetration Procedures - The penetration procedures from the radio beacons, which are described in the separate plans, were, with only minor exceptions, the same at the assault base and fixed base. Basically, 45 degrees divergence was established between the three penetration legs. The aircraft, except where noted, maintained altitude for 30 seconds after passing the radio beacon to permit turn to the outbound track, and to reduce speed prior to commencing descent. Upon

DEPARTURE FROM ASSAULT BASE PLAN IIB

R-22 Track 207° from the OB Rbn, maintain Visual Flight Conditions for 2 minutes 45 seconds, then climb to and maintain 3600 feet. Upon leaving 2500 feet, proceed direct to the SL Rbn. Track 306° from the SL Rbn, maintain 3600 feet for 30 seconds, then descend to Visual Flight Conditions (200 feet). Upon reaching Visual Flight Conditions, turn right to intercept a track of 136° to the Fixed Base Rbn.

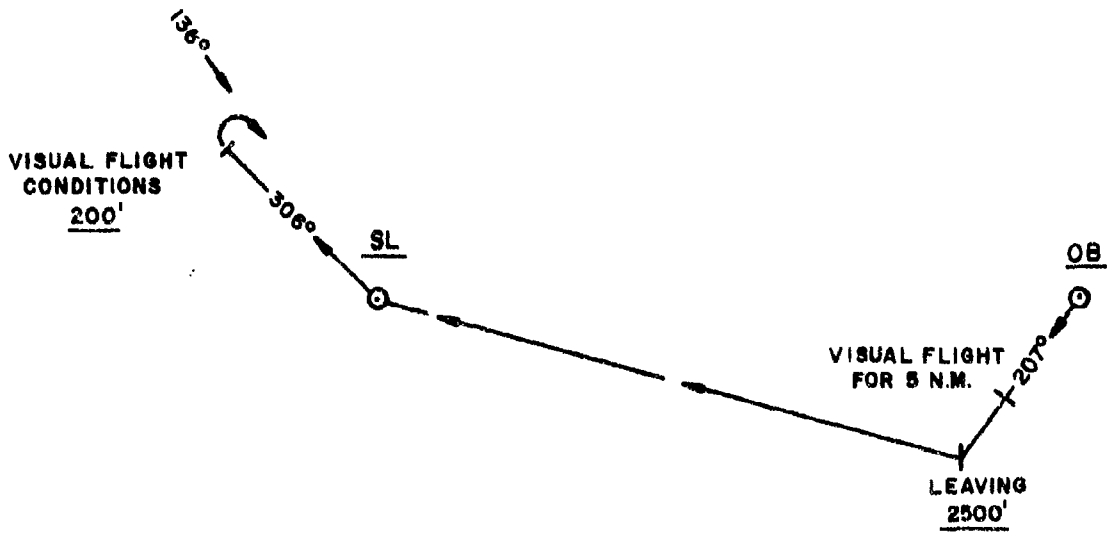


FIG. 16 SAMPLE OF DEPARTURE CLEARANCE FROM ASSAULT BASE

reaching 200 feet above ground level and visual flight conditions, the pilot turned right to join a specified inbound track to the radio beacon. This return track provided 10 degrees divergence from the outbound penetration track. In those plans using more than three altitudes toward the assault base, dual occupancy of each penetration leg became necessary. This procedure was designed to provide 1200 feet of vertical separation between two helicopters on the same penetration leg at the time of commencing descent. In the case of UH-1 Helicopters descending at 60 knots and 800 FPM, a theoretical distance of 1.5 nautical miles existed longitudinally between two penetrations on the same leg upon reaching 200 feet above ground level. Separation between two CH-47 Helicopters descending at 70 knots and 1000 FPM is only slightly less. When less than 1200 feet vertical separation existed at time of beginning descent (i.e. emergency return to fixed base in Plans I, III, and IV), or helicopter types were mixed, adjustment was made in the plans to preclude compromise to the separation.

Emergency Procedures - Recognizing the vulnerability of a continuously operating radio transmitter to jamming techniques, and giving special consideration to inherent limitations of a portable type non-directional beacon, emergency procedures were devised to return all flights to the fixed base, should it become necessary.

The emergency return was initiated by a command for execution issued simultaneously by controllers at the fixed and assault bases. Coordination was first effected by the assault base controller who normally should be cognizant of the operational status of the radio beacon. With the exception of Plan IV, the procedures specify a 100 degree turn to the right (or left in some plans) to intercept a return track to the fixed base radio beacon. The return track represented a 10 degree divergence from the outbound track. If a pilot failed to receive the command for execution of the emergency return, the aircraft continued in the direction of the assault base, while all other aircraft were on the off-course track. Due to the variance in off-course time for those aircraft successively further from the fixed base, longitudinal separation was greater during the return to fixed base.

Emergency procedures were further expanded to incorporate missed approaches as a result of deterioration of weather. Timing was important in the execution of any missed approach. In these plans, if the pilot did not find visual flight conditions immediately upon reaching 200 feet above ground level, the missed approach had to be commenced and precisely executed. In a missed approach, the pilot broke radio silence immediately and reported aircraft identification, heading, and missed approach altitude to the assault base controller.

Dynamic Simulation Test Results: Upon completion of the simulation, during which the plans were refined, modified, and combined, six operational plans resulted. Each plan specifies procedures, navigation requirements, and air traffic control requirements to move a specific number of helicopters.

Controller manpower requirements for all plans were established at two - one located at the fixed base and one at the assault base. Due to the minimum separation values used, the volume of operations, the unique penetration, missed approach and emergency procedures, a high degree of controller proficiency was found necessary. The two controllers were able to perform the duties specified for each plan with little difficulty during the simulation but all of the factors of field operation were not present. It is possible that two additional controllers whose main duties would be to aid in marshalling helicopters to the departure point and performing flight data duties, one at the assault and one at the fixed base, would be required in live operation.

During the course of simulation runs, the problem was frozen, i.e., all target generators were stopped at the same time. Freezes were made during departure, enroute, approach and emergency operations. An examination of helicopter positions by altitude layer did not reveal that conflict situations were in existence or developing. Photographs were taken of the radar scopes which were used to monitor the operation during the simulation of Plan II-B. Figure 17 is a photograph of the normal traffic flow of aircraft enroute from the fixed base to the assault base. Figure 18 is a photograph of the traffic shortly after the emergency return procedure was initiated. Figure 19 is a photograph of the aircraft at one altitude, 800 feet, which was taken to show separation of targets after the aircraft were established on the return track to the fixed base.

The separation values used during the simulation tests did not inhibit controllers from handling the movement rates prescribed for each plan. The procedures, as modified during simulation, were adequate for the control of both normal and emergency situations and provided the necessary information for the pilots to conform with each operational plan.

The number of scheduled operations, which in turn affected the number of altitudes used and the complexity of departure, penetration and emergency procedures, established Plans I and I-B as the easiest to organize and control.

The use of radio for routine traffic control during dynamic simulation was in lieu of visual signals which would most likely be employed

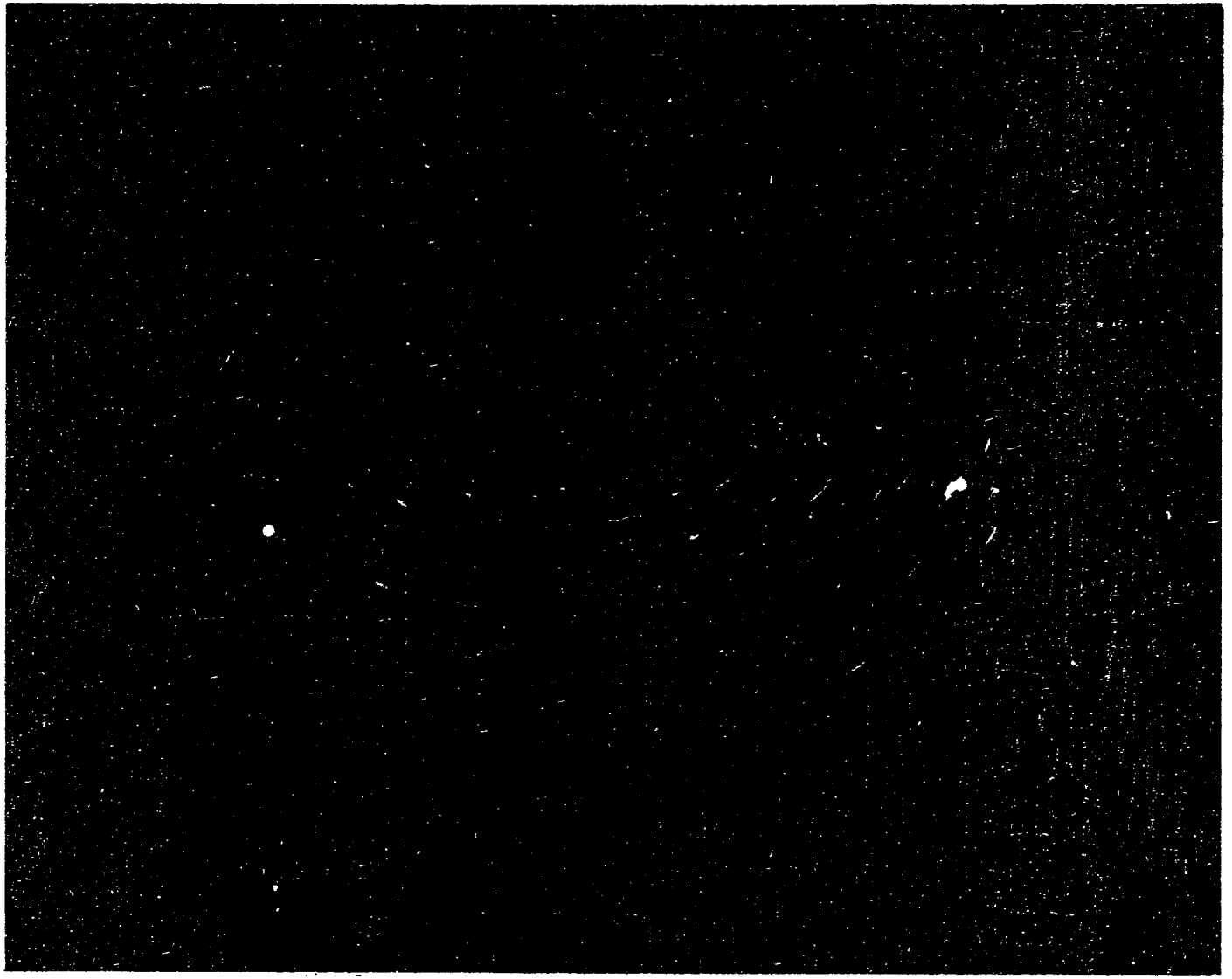


FIG. 17 PHOTOGRAPH OF RADAR TARGETS DURING NORMAL OPERATIONS - PLAN II-B

FIG. 18 TIMED PHOTOGRAPH OF RADAR TARGETS OF AIRCRAFT EXECUTING THE EMERGENCY RETURN PROCEDURE PLAN II-B

FIG. 19 PHOTOGRAPH OF RADAR TARGETS OF AIRCRAFT AT THE 800 FOOT LEVEL AFTER EXECUTING THE EMERGENCY RETURN PROCEDURE - PLAN II-B

during a tactical operation in order to keep communications at a minimum. If voice communications were to be used, the discrete radio channel for each base and point-to-point voice channel between each base would be adequate for controlling the traffic in each plan. Through briefing prior to the departure from the fixed base and the use of semaphore, large hand cards, or by the manual transfer of written records, voice communication requirements could be reduced to a minimum except during emergency situations. It was found desirable that pilots monitor a single common frequency throughout the entire flight. This permitted direct air-ground communication between pilots and controllers, when required, and provided means for controller coordination, when necessary.

It became evident that a precise determination of ceiling values and accurate estimates of prevailing visibility would be essential in order that the probability of a missed approach or multiple missed approaches be reduced to a minimum. In the event of sudden deterioration of weather and multiple missed approaches, the system tolerated normal flight deviations but was seriously compromised by any abbreviation of the procedures. After passing the assault base radio beacon, the pilot was committed to complete execution of the penetration to 200 feet above ground level, followed by the complete missed approach procedure. Second approaches, in the event of a missed approach, were found not practical at the assault base in Plans II, II-B, III, or IV.

By using a departure control chart in which a departure interval is programmed, the controller workload was kept at a minimum. The traffic control system was so designed that like-type helicopters were assigned a specific route, altitudes, and airspeed.

SUMMARY OF RESULTS

1. During the live-tests the mean difference in pilot performance between the assigned airspeed of 80 knots and the observed airspeed was 0.35 knots below the assigned.

2. During the live-tests the mean difference in pilot performance between the assigned altitude and the observed altitude was 7.06 feet above the assigned.

3. Plots of tracking during the live-tests showed some extreme deviations from the assigned flight path.

4. The use of 60 knots and 800 FPM for tactical approaches reduced the excessive flight distances occuring beyond the approach fix.

5. The following basic separation values (including buffer requirements) were derived from the live tests and used during the simulation.

Vertical:

Four hundred feet

Longitudinal:

80 Knots IAS - 5 minutes
110 Knots IAS - 4 minutes

Lateral:

Route widths 6 NM (3 NM each side of the direct course)
Simultaneous Departures - 30 degrees divergence
Opposite direction traffic - 45 degrees divergence

6. Pilots participating in the live-tests expressed no adverse opinions of the departure and approach procedures.

7. Six operational plans resulted from the simulation; each plan handled the rated number of helicopter movements established for each plan, including the specified mixture of helicopter types. The capacity of the six plans ranged from 24 to 78 arrivals per hour at the assault base. The procedures handled both normal and emergency situations. Plans I and I-B were the easiest to organize and control.

8. Two Air Traffic Controllers experienced in handling instrument traffic were used, one at the fixed base and one at the assault base.

9. The discrete radio communication channel for each base and the point-to-point voice channel between bases were required for controlling the traffic in each plan.

10. By using departure control charts in which departure intervals were programmed, the controller workload was kept at a minimum.

11. Second approaches were not practical at the assault base in Plans II, II-B, III, or IV. Precise determination of ceiling and visibility values were essential to minimize missed approaches in all plans.

12. The consensus of controllers' subjective opinion was that the operational plans were suitable for further live testing.

CONCLUSIONS

Based on the results of the live tests and the simulation of six operational plans for use in helicopter assault missions under instrument flight conditions, as conducted under Project 150-530-01V, it is concluded that:

1. The procedures, as described in this report for each of the six plans, are adequate for moving the rates of helicopters prescribed for each plan.

2. The basic separation values of;

   (a) one minute between successive departures,

   (b) with a divergence of 30 degrees between departure tracks,

   (c) with a minimum vertical separation of 400 feet,

   (d) with a longitudinal separation of 5 minutes for helicopters at 80 knots and 4 minutes for helicopters at 110 knots, and,

   (e) with a divergence of 45 degrees between inbound and outbound tracks, are satisfactory for use in these plans provided the values are further validated through additional live testing.

3. Nondirectional radio beacons (which provide complete coverage of the routes to be flown), ADF receivers, and Radio Magnetic Compass Indicators provide adequate departure and enroute navigation facilities for each plan. Further live-tests are necessary to determine the final adequacy of such facilities for multiple approaches.

4. A minimum of two Air Traffic Control Specialists, one at the fixed base and one at the assault base, are required for dispatching departures and coordinating the execution of emergency procedures.

5. A high degree of pilot and controller proficiency is required for each plan to function successfully.

RECOMMENDATIONS

Based on the evaluation of the operational plans, it is recommended that:

1. The procedures, separation values, and basic navigation and air traffic control requirements, provided in this report, be considered for use by the U. S. Army in the conduct of helicopter assault missions.

2. Further live tests be conducted by the U. S. Army to validate the procedures, separation values and basic requirements under actual field conditions.

ACKNOWLEDGEMENT

The NAFEC project personnel wish to acknowledge the valuable assistance of the following:

Major Chester R. Mead, U. S. Army Project Officer, 11th Air Assault Division, Fort Benning, Georgia, for his technical guidance and support.

The Third Aviation Company (AML), 11th Air Assault Division, Fort Benning, Georgia, for participation in the live-flight tests.

Air Traffic Controllers from the 11th Air Assault Division, Fort Benning, Georgia, for participation in dynamic simulation tests.

Lt. Col. Ellis C. Langford (U. S. Army Ret.), NAFEC, for technical guidance.

Lt. Col. John Hunt (USAF) and Mr. John J. Maurer, who participated as Evaluation Division team members.

APPENDIX I

PLAN I

General: This is the simplest and most basic of all the plans tested. Two altitudes are used enroute from the fixed base to the assault base, and two for the return from the assault base to the fixed base.

Using the UH-1 series helicopters with a 5-minute longitudinal separation, this plan gives a theoretical arrival rate of 24 aircraft per hour at the assault base. If the CH-47 or other helicopters of a similar speed are used with four-minute longitudinal separation, this plan will then permit a theoretical arrival rate of 30 aircraft per hour at the assault base.

This plan requires one nondirectional radio beacon at the fixed base and a portable nondirectional radio beacon at the assault base.

Departures from the Fixed Base: Departures from the fixed base are cleared according to the Departure Control Chart-Fixed Base (FIG. I-1). This plan will permit an increase of departure interval to allow two minutes between successive departures with an appropriate adjustment on the departure control chart to insure longitudinal separation. This would not affect the theoretical arrival rate of 24 aircraft per hour at the assault base. Figure I-2 illustrates the departure procedure from the fixed base along with a complete flow diagram of the entire plan.

Penetration Procedure at Assault Base: Since this plan uses only two enroute altitudes, there are only two penetration legs at the assault base. The aircraft at the lowest altitude makes a 45 degree turn to the left and the aircraft at the higher altitude makes a 45 degree turn to the right when passing the assault base radio beacon. This provides 90 degrees separation between penetration legs (FIG. I-2).

Departures from the Assault Base: The controller issues clearances to aircraft departing the assault base, as they are ready for take-off, in the sequence shown in the Departure Control Chart-Assault Base (FIG. I-3). Figure I-2 shows the departure procedure. The return clearance ("R" clearance) gives the pilot complete information including the penetration at the fixed base.

Penetration at the Fixed Base: Penetration procedures at the fixed base are identical to those used at the assault base with the exception that the aircraft maintain their altitude for 1 minute after passing the radio beacon, rather than 30 seconds (FIG. I-2). The 1-minute time restriction placed on the aircraft on the normal return clearance is established to protect the lower altitudes in the event of an emergency return.

Emergency Return Procedure: In the event the emergency return procedure is initiated by the controllers, the aircraft enroute between the fixed base and the assault base, make a right turn to a heading of 181° to intercept a track of 271° to the fixed base (FIG. I-4). (Aircraft penetrating from the SL radio beacon on the same penetration leg have only 800 feet vertical separation, so the added time is assigned to the normal arrivals to maintain the desired separation of 1.5 NM at the time the aircraft reach an altitude of 200 feet.)

Controller Duties During Emergency Return Procedure: Controller action during emergency return, as in any emergency situation, is an extremely important function. Each of the controllers have specific functions to perform prior to the initiation of the emergency return procedure. Following is a list of functions required by the controllers and, whenever possible, should be carried out in the order listed.

Assault Base Controller:

1. Coordinate with the fixed base controller and advise that the emergency return procedure is to be initiated.

2. Broadcast to all aircraft enroute from the fixed base to the assault base to execute the emergency return procedure.

Fixed Base Controller:

1. Stop departures.

2. Ascertain that all departures have reached their assigned altitudes.

3. Advise the assault base controller that the emergency return procedure may be initiated.

4. Broadcast to all the aircraft enroute from the fixed base to the assault base, to execute the emergency return procedure.

In the event that separate frequencies are being utilized at the fixed base and the assault base, it is imperative that the fixed base controller initiate the emergency return procedure prior to or simultaneously with the assault base controller to assure that aircraft will maintain or increase their longitudinal separation during the execution of the emergency return procedure. It is for this reason, that if possible, a common frequency should be used.

Missed Approach: The missed approach procedure is shown in Figure I-5. Upon reaching the missed approach altitude a left turn is made direct to the assault base nondirectional radio beacon (NDB). Prior to arrival over the assault base radio beacon, the pilot is given additional clearance. The controller has the option of issuing a clearance back to the fixed base or a clearance for a second approach. If the aircraft returns to the fixed base, a departure clearance from assault base ("R" clearance) is issued for the appropriate altitude. Since the aircraft is already at assigned altitude, the visual flight conditions restriction on the "R" clearance does not apply. However, to maintain longitudinal separation from a preceding departing aircraft at the same altitude, the off course track for the "R" clearance is assigned for a period of five minutes prior to turning toward the fixed base. Second approaches to the fixed base are started from the missed approach altitude and an approach procedure is specified by the Controller. Necessary reports are requested of the pilot.

Controller Duties During Missed Approach:

Return to Fixed Base -

1. Discontinue departures. (Altitudes assigned to missed approaches are the same as those assigned to departures from the assault base).

2. Issue "R" clearance corresponding to the altitude of the missed approach, with appropriate off course restriction.

3. Obtain necessary reports for subsequent release of departures from the assault base.

Second Approaches -

1. Discontinue departures.

2. Specify the penetration procedure for a second approach.

3. Obtain necessary reports for subsequent release of departures from the assault base.

The controllers are furnished a chart which indicates the penetration leg which should be assigned an aircraft to correspond with a particular assigned altitude and also a time restriction. A 1-minute restriction for maintaining assigned altitude after passing the assault base NDB is required due to the fact there would be less than 1200 feet vertical separation on the penetration legs.

Assigned Altitude	Penetration Leg	Time Restriction
1200 ft.	036°	1 min.
1600 ft.	126°	1 min.

Clearances: The following clearances are used in this plan:

A. Departure from Fixed Base:

D-1 Track 081° from the SL Rbn, climb to and maintain 400 feet. Track 036° from the OB Rbn, maintain 400 feet for 30 seconds then descend to visual flight conditions (200 feet). Upon reaching visual flight conditions, turn right to intercept a track of 226° to the Assault Base Rbn.

Missed Approach Procedure -

Turn left heading 351°, maintain altitude of 200 feet for 30 seconds, then climb to 1200 feet. Upon reaching 1200 feet, turn left, proceed direct to the OB Rbn. Proceed as directed by the OB Controller.

D-2 Track 081° from the SL Rbn, climb to and maintain 800 feet. Track 126° from the OB Rbn, maintain 800 feet for 30 seconds then descend to visual flight conditions (200 feet). Upon reaching visual flight conditions, turn right to intercept a track of 316° to the Assault Base Rbn.

Missed Approach Procedure -

Turn left heading 081°, maintain altitude of 200 feet for 30 seconds, then climb to 1600 feet. Upon reaching 1600 feet, turn left, proceed direct to the OB Rbn. Proceed as directed by the OB Controller.

B. Departure from Assault Base:

R-1 Track 306° from the OB Rbn, maintain visual flight conditions at or below 200 feet for 3 min. 45 sec. after passing the Rbn, then climb to and maintain 1200 feet. Upon leaving 900 feet, proceed direct to the SL Rbn. Track 216° from the SL Rbn maintain 1200 feet for 1 minute then descend to visual flight conditions (200 feet). Upon reaching visual flight conditions turn right to intercept a track

of 046° to the Fixed Base Rbn.

R-2 Track 306° from the OB Rbn, maintain visual flight conditions at or below 200 feet for 3 min. 45 sec. after passing the Rbn, then climb to and maintain 1600 feet. Upon leaving 900 feet, proceed direct to the SL Rbn. Track 306° from the SL Rbn maintain 1600 feet for 1 minute then descend to visual flight conditions (200 feet). Upon reaching visual flight conditions turn right to intercept a track of 136° to the Fixed Base Rbn.

C. Emergency Return Procedure:

Turn right to a heading of 181°, maintain assigned altitude. Maintain 181° heading until intercepting a bearing of 271° to the SL Rbn. Track on a heading of 271° to the SL Rbn.

See Figure I-4 for illustration of the penetration procedures when making an emergency return to fixed base.

DEPARTURE CONTROL CHART FIXED BASE

SCHEDULED DEPARTURE TIME	ACFT. IDENT.	TYPE ACFT.	CLEARANCE ALTITUDE	SCHEDULED DEPARTURE TIME	ACFT. IDENT.	TYPE ACFT.	CLEARANCE ALTITUDE
:00		UH - 1	D-1 / 400'	:30		UH - 1	D-1 / 400'
:00				:30			
:01		UH - 1	D-2 / 800'	:31		UH - 1	D-2 / 800'
:01				:31			
:02				:32			
:02				:32			
:03				:33			
:03				:33			
:04				:34			
:04				:34			
:05		UH - 1	D-1 / 400'	:35		UH - 1	D-1 / 400'
:05				:35			
:06		UH - 1	D-2 / 800'	:36		UH - 1	D-2 / 800'
:06				:36			
:07				:37			
:07				:37			
:08				:38			
:08				:38			
:09				:39			
:09				:39			
:10		UH - 1	D-1 / 400'	:40		UH - 1	D-1 / 400'
:10				:40			
:11		UH - 1	D-2 / 800'	:41		UH - 1	D-2 / 800'
:11				:41			
:12				:42			
:12				:42			
:13				:43			
:13				:43			
:14				:44			
:14				:44			
:15		UH - 1	D-1 / 400'	:45		UH - 1	D-1 / 400'
:15				:45			
:16		UH - 1	D-2 / 800'	:46		UH - 1	D-2 / 800'
:16				:46			
:17				:47			
:17				:47			
:18				:48			
:18				:48			
:19				:49			
:19				:49			
:20		UH - 1	D-1 / 400'	:50		UH - 1	D-1 / 400'
:20				:50			
:21		UH - 1	D-2 / 800'	:51		UH - 1	D-2 / 800'
:21				:51			
:22				:52			
:22				:52			
:23				:53			
:23				:53			
:24				:54			
:24				:54			
:25		UH - 1	D-1 / 400'	:55		UH - 1	D-1 / 400'
:25				:55			
:26		UH - 1	D-2 / 800'	:56		UH - 1	D-2 / 800'
:26				:56			
:27				:57			
:27				:57			
:28				:58			
:28				:58			
:29				:59			
:29				:59			

FIG. I-1 DEPARTURE CONTROL CHART - FIXED BASE - PLAN I

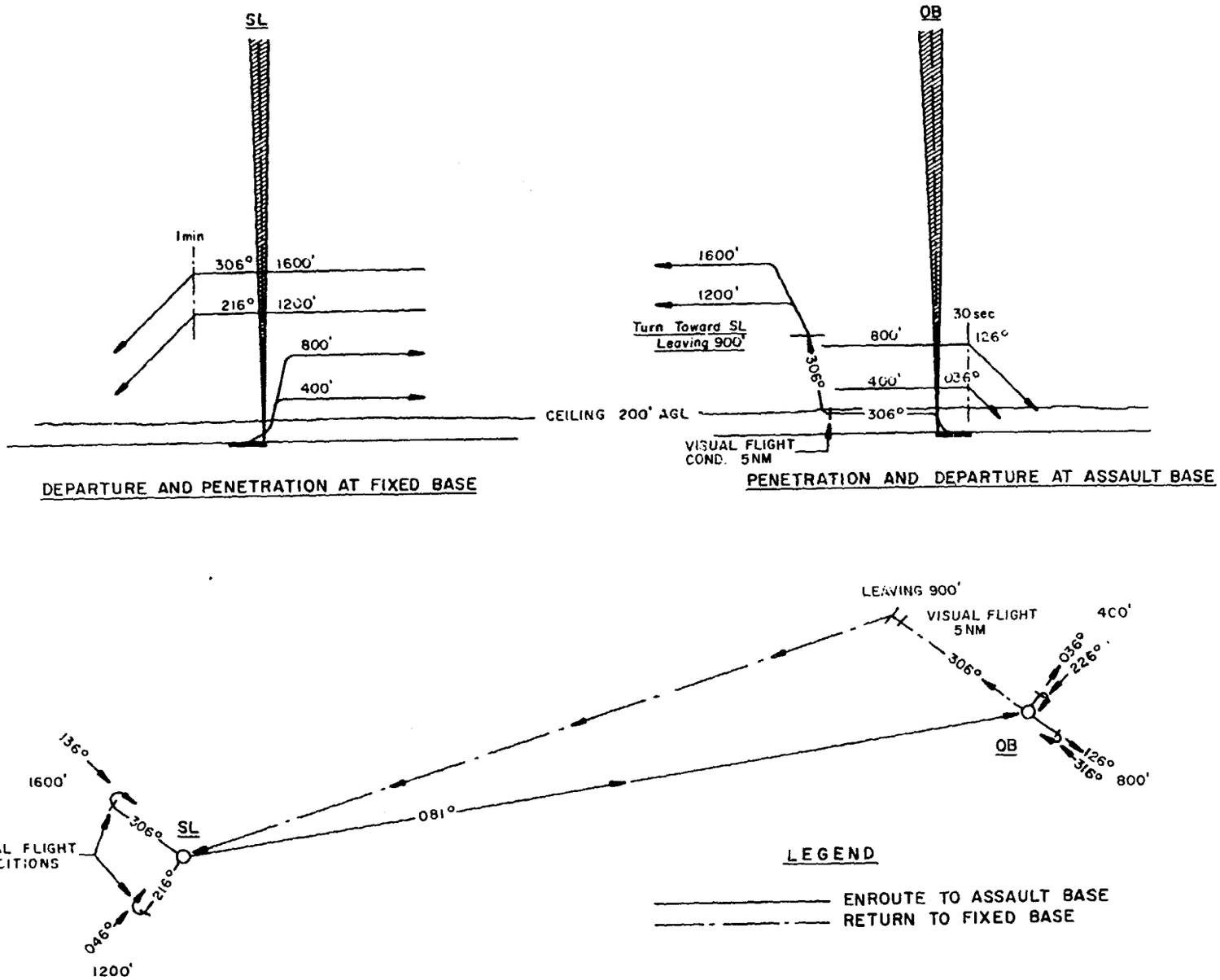


FIG. I-2 DEPARTURE, PENETRATION PROCEDURES, AND TRAFFIC FLOW DIAGRAM - PLAN I

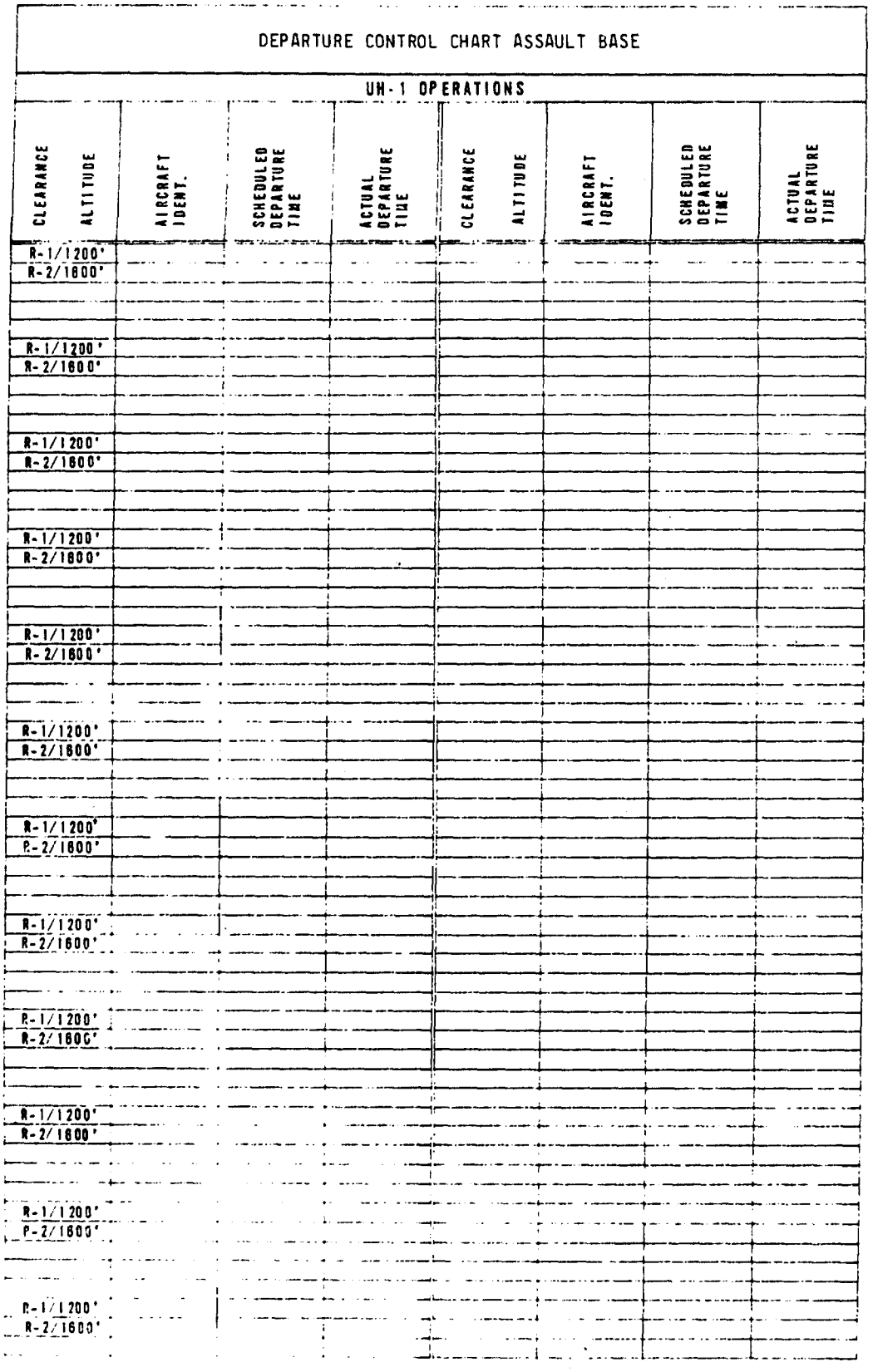
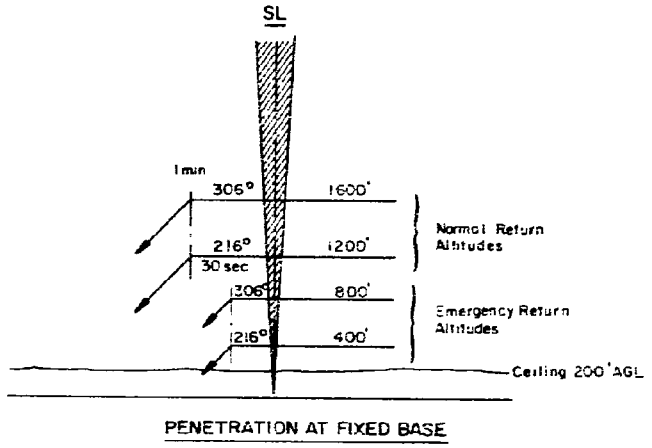


FIG. I-3 DEPARTURE CONTROL CHART - ASSAULT BASE - PLAN I



PENETRATION AT FIXED BASE

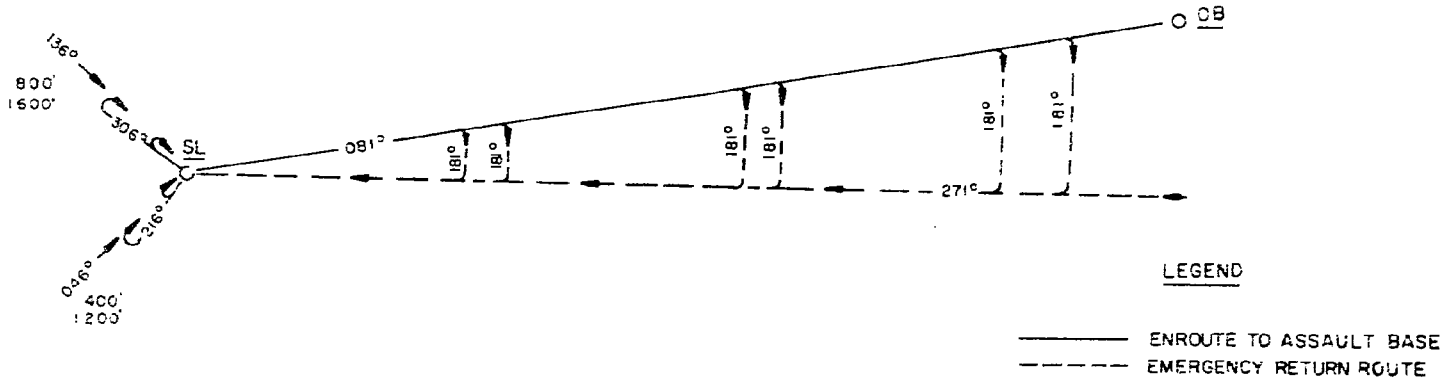


FIG. I-4 EMERGENCY RETURN AND PENETRATION PROCEDURE - PLAN I

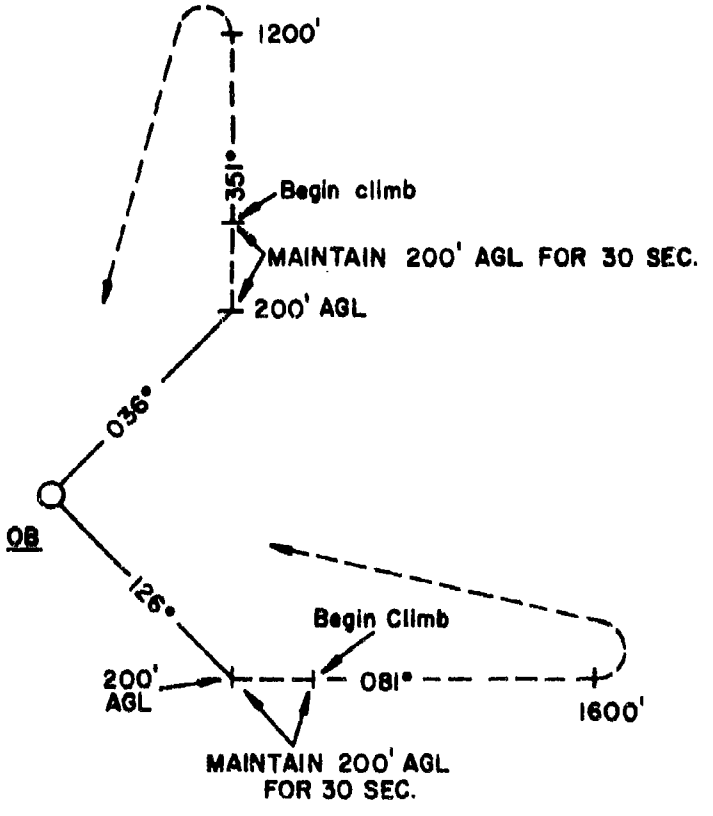


FIG. I-5 MISSED APPROACH PROCEDURE - PLAN I

APPENDIX II

PLAN I-B

General: In this plan 3 altitudes are used enroute from the fixed base to the assault base and 3 altitudes returning to the fixed base for a total of 6 altitudes. The additional altitudes in this plan are added to handle CH-47 or like-type helicopters along with the UH-1's.

Navigational requirements for this plan are the same as those in Plan I, using one NDB at the fixed base and a portable NDB at the assault base.

Considering a movement rate of 12 UH-1 type helicopters per hour per altitude, utilizing 5-minute time separation between aircraft; and 15 per hour per altitude for the CH-47 type helicopters, utilizing 4 minutes separation between aircraft, gives this plan the theoretical arrival rate of 39 aircraft per hour at the assault base.

Departures from Fixed Base: Basically, departure procedures in this plan are the same as in Plan I. The difference is the addition of an off-course departure route and track to the assault base which is utilized by the CH-47 type helicopters (FIG. II-1).

Departures are controlled from the fixed base as they were in Plan I by utilization of a Departure Control Chart (FIG. II-2). CH-47 Helicopters depart simultaneously with UH-1's.

Penetration Procedure at Assault Base: A third penetration leg is added in this plan (FIG. II-1). This provides a separate penetration leg for each altitude, and also segregates the two types of aircraft.

Departures from the Assault Base: A separate departure track for use by the CH-47's is added in this plan (FIG. II-1). Departures are cleared off the assault base by the controller in accordance with the Departure Control Chart-Assault Base (FIG. II-3). The departure Control Chart is designed in two sections. One section is used to control the UH-1 departures and the second section refers to the CH-47's only, and the controller handles his traffic on the basis of timing his departures by type helicopter.

Penetration at the Fixed Base: Penetration procedures at the fixed base are identical to those at the assault base. In Plan I, a time restriction was necessary to protect lower altitudes in the event of an Emergency Return, but is not necessary in this plan (FIG. II-1).

Emergency Return Procedure: Upon initiation of the emergency return, the UH-1 aircraft make right turns of approximately 100 degrees from their outbound track (FIG. II-4). The heading to which they turn is specified in the emergency return portion of their clearance. The CH-47 pilot, after ascertaining position relative to the return track, turns to the right or left as necessary to intercept the return track to the fixed base NDB. Upon reaching the fixed base NDB, the aircraft make a normal penetration on the designated penetration leg. The CH-47 departure route from assault base is on the same side of the direct route as the emergency return procedure and there is some interaction which must be resolved by the controller at the assault base prior to initiation of the emergency return procedure.

Controller Duties During Emergency Return Procedure:

Assault Base Controller -

1. Coordinate with the fixed base controller, advise that the emergency return procedure is to be initiated.

2. Stop all CH-47 departures. (If any CH-47's have departed, the controller must ascertain the aircraft's altitude. The emergency return procedure should not be initiated until the last CH-47 Helicopter which has departed, has reached an altitude at least 100 feet above the highest enroute altitude to the assault base.)

3. Broadcast to all aircraft enroute from the fixed base to the assault base to execute the emergency return procedure.

Fixed Base Controller -

1. Stop all departures.

2. Ascertain that all departures have reached their assigned altitudes.

3. Advise the assault base controller that the emergency return procedure may be initiated.

4. Broadcast to all aircraft enroute from the fixed base to the assault base to execute the emergency return procedure. (Must be accomplished by the fixed base controller prior to or simultaneously with the assault base controller's broadcast).

Missed Approach: The missed approach procedure is shown in Figure II-5. Upon reaching the missed approach altitude, a left turn is made direct to the assault base NDB. Prior to arrival over the assault base NDB, the pilot must be given additional clearance. The controller has the option of issuing a clearance back to the fixed base or a clearance for a second approach. Procedures to be followed for return to fixed base or second approaches are identical to those in the missed approach section of Plan I.

Controller Duties: During missed approach the same procedures used in Plan I are followed by the Controllers. The only difference in this plan is the chart prepared for the controllers use in authorizing second approaches.

The appropriate penetration legs for each missed approach altitude are listed in the following chart:

Missed Approach Altitude	Penetration Leg	Time Restriction
1600 ft.	036°	30 sec.
2000 ft.	081°	30 sec.
2400 ft.	126°	30 sec.

Clearances: The following clearances are used in this plan:

A. Departure from Fixed Base:

D-1 Track 081° from the SL Rbn, climb to and maintain 400 feet. Track 036° from the Ob Rbn, maintain 400 feet for 30 seconds then descend to visual flight conditions (200 feet). Upon reaching visual flight conditions, turn right to intercept a track of 226° to the Assault Base Rbn.

Missed Approach Procedure -

Turn left heading 351°, maintain 200 feet for 30 seconds then climb to 1600 feet. Upon reaching 1600 feet, turn left, proceed direct to the OB Rbn. Proceed as directed by the OB Controller.

D-2 Track 081° from the SL Rbn, climb to and maintain 800 feet. Track 081° from the OB Rbn, maintain 800 feet for 30 seconds then descend to visual flight conditions (200 feet). Upon reaching visual flight conditions, turn right to intercept a track of 271° to the Assault Base Rbn.

Missed Approach Procedure -

Turn left heading 036°, maintain 200 feet for 30 seconds, then climb to 2000 feet. Upon reaching 2000 feet, turn left, proceed direct to the OB Rbn. Proceed as directed by the OB Controller.

D-3 Track 111° from the SL Rbn, climb to and maintain 1200 feet. Maintain track of 111° until intercepting a bearing of 252° from the OB Rbn. Track 072° to the OB Rbn. Track 126° from the OB Rbn, maintain 1200 feet for 30 seconds, then descend to visual flight conditions (200 feet). Upon reaching visual flight conditions, turn right to intercept a track of 316° to the Assault Base Rbn.

Missed Approach Procedure -

Turn left heading 081°, maintain 200 feet for 30 seconds, then climb to 2400 feet. Upon reaching 2400 feet, turn left, proceed direct to the OB Rbn. Proceed as directed by the OB Controller.

B. Departure from Assault Base

R-1 Track 306° from the OB Rbn, maintain visual flight conditions at or below 200 feet for 3 min. 45 sec. after passing the Rbn, then climb to and maintain 1600 feet. Upon leaving 1300 feet, proceed direct to the SL Rbn. Track 216° from the SL Rbn, maintain 1600 feet for 30 seconds then descend to visual flight conditions (200 feet). Upon reaching visual flight conditions, turn right to intercept a track of 046° to the Fixed Base Rbn.

R-2 Track 306° from the OB Rbn, maintain visual flight conditions for 3 min. 45 sec. after passing the Rbn, then climb to and maintain 2000 feet. Upon leaving 1300 feet, proceed direct to the SL Rbn. Track 261° from the SL Rbn, maintain 2000 feet for 30 seconds then descend to visual flight conditions (200 feet). Upon reaching visual flight conditions turn right to intercept a track of 091° to the Fixed Base Rbn.

R-3 Track 207° from the OB Rbn, maintain visual flight conditions at or below 200 feet for 2 min. 45 sec. after passing the Rbn, then climb to and maintain 2400 feet. Upon leaving 1300 feet, proceed direct to the SL Rbn. Track 306° from the SL Rbn, maintain 2400 feet for 30 seconds then descend to visual flight conditions (200 feet). Upon reaching visual flight conditions turn right to intercept a track of 136° to the Fixed Base Rbn.

C. Emergency Return Procedure:

Intercept 091° bearing from SL Rbn. Track 271° to the SL Rbn. Maintain assigned altitude.

Acft. South of 091° bearing from SL Rbn.

Turn left heading 001° to intercept.

Acft. North of 091° bearing from SL Rbn.

Turn right heading 181° to intercept.

See Figure II-4 for illustration of the penetration procedures when making an emergency return to fixed base.

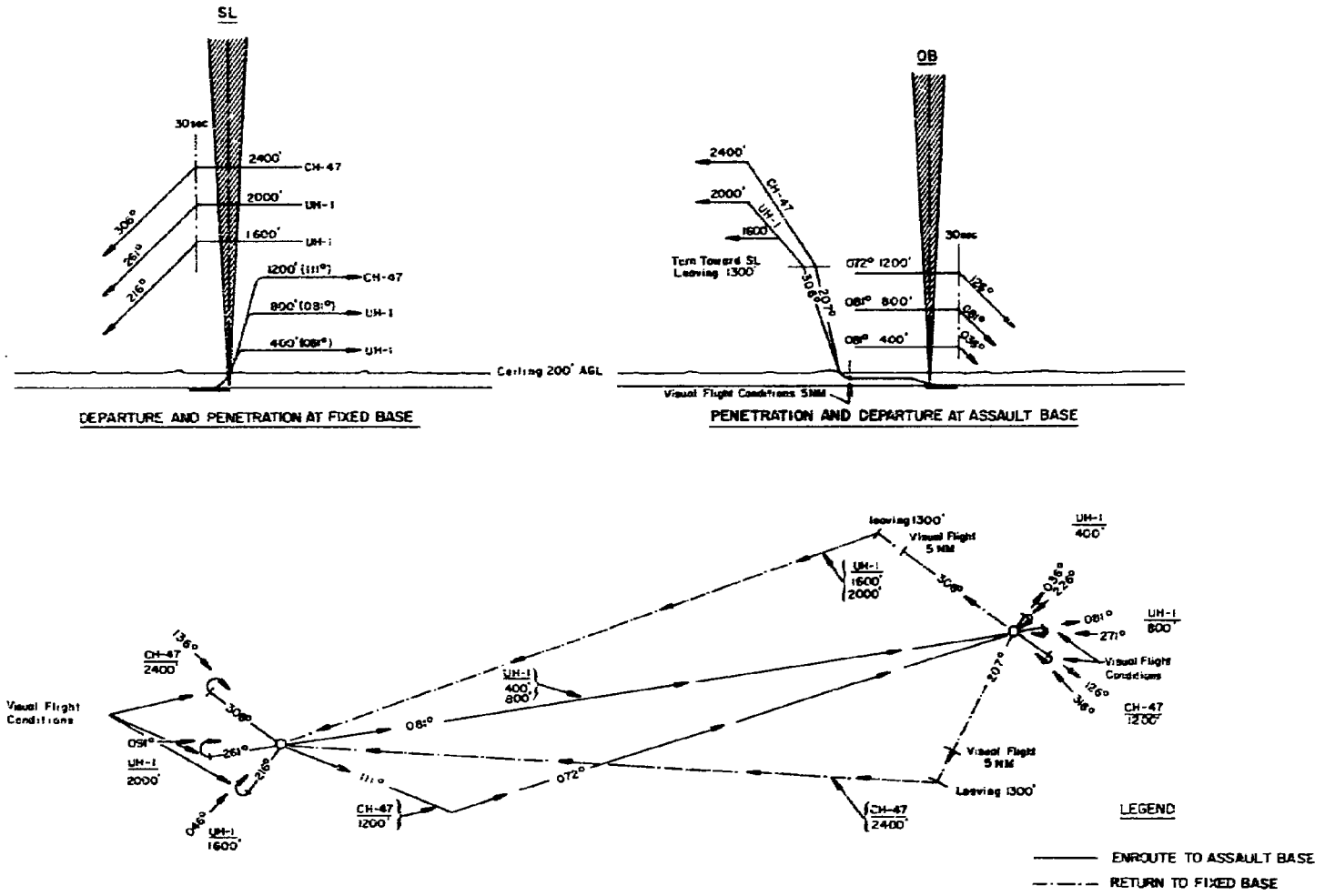
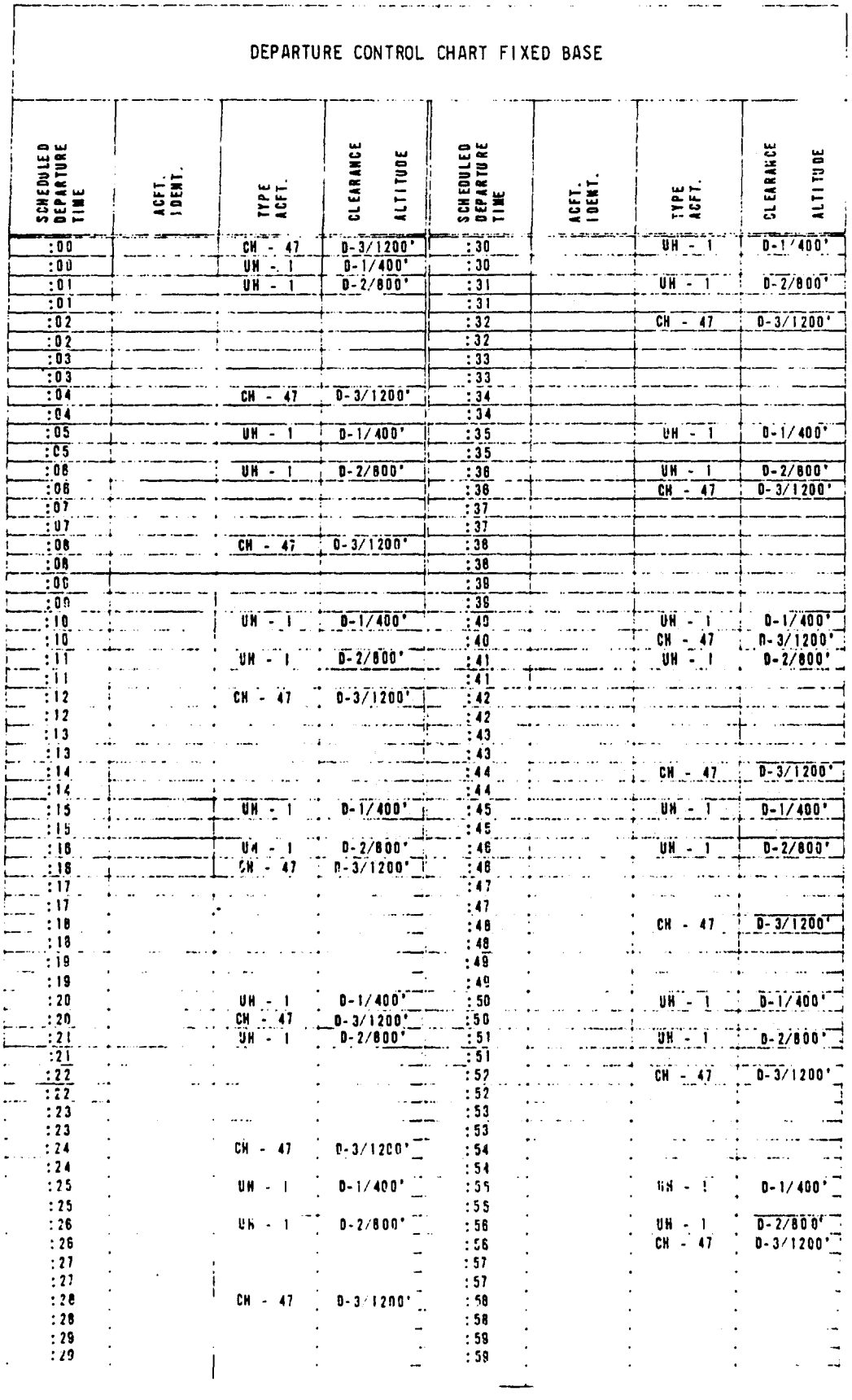


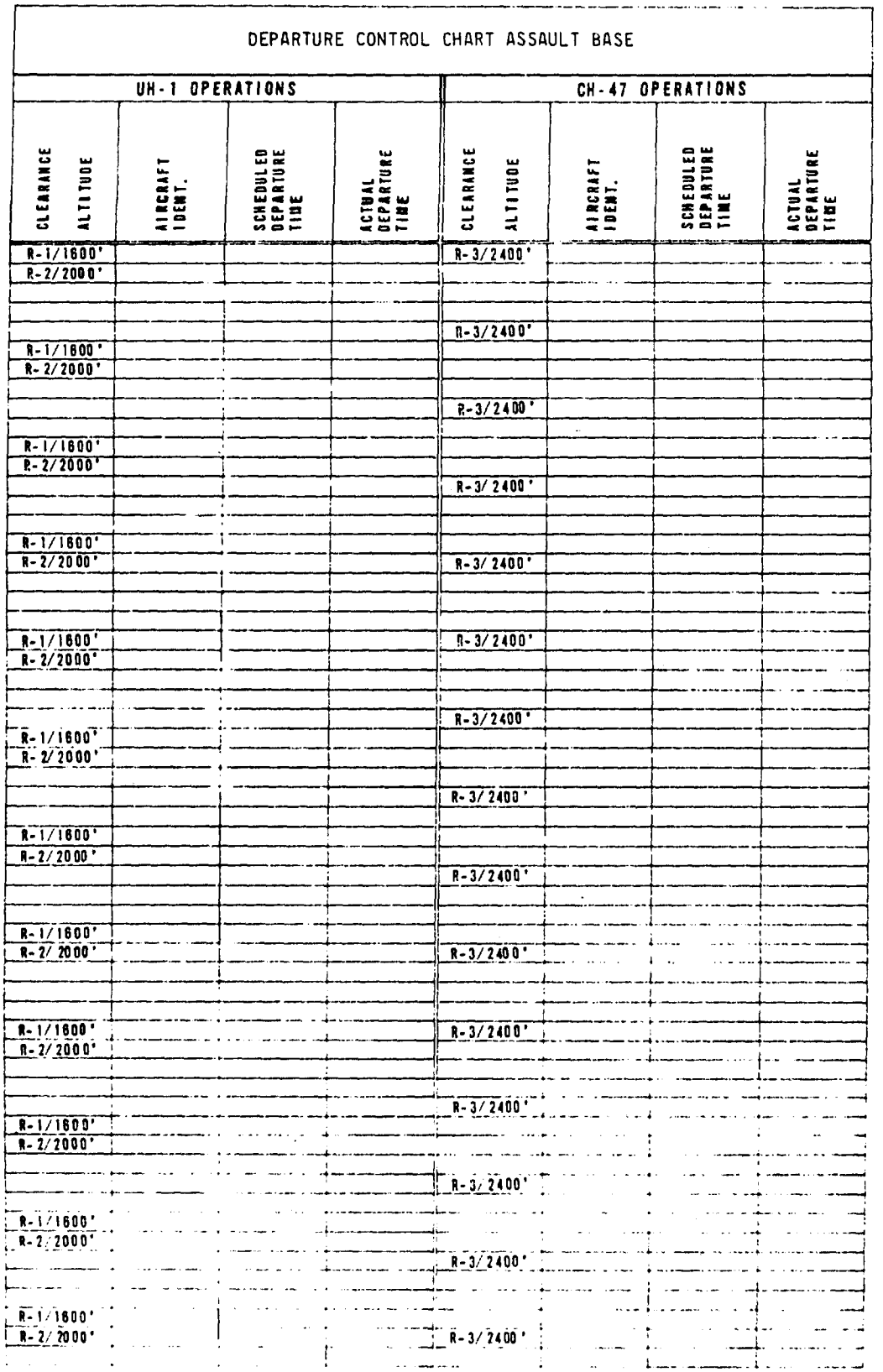
FIG. II-1 DEPARTURE, PENETRATION PROCEDURES, AND TRAFFIC FLOW DIAGRAM - PLAN I-B



DEPARTURE CONTROL CHART FIXED BASE

SCHEDULED DEPARTURE TIME	ACFT. IDENT.	TYPE ACFT.	CLEARANCE ALTITUDE	SCHEDULED DEPARTURE TIME	ACFT. IDENT.	TYPE ACFT.	CLEARANCE ALTITUDE
:00		CH - 47	D-3/1200'	:30		UH - 1	D-1/400'
:00		UH - 1	D-1/400'	:30			
:01		UH - 1	D-2/800'	:31		UH - 1	D-2/800'
:01				:31			
:02				:32		CH - 47	D-3/1200'
:02				:32			
:03				:33			
:03				:33			
:04		CH - 47	D-3/1200'	:34			
:04				:34			
:05		UH - 1	D-1/400'	:35		UH - 1	D-1/400'
:05				:35			
:06		UH - 1	D-2/800'	:36		UH - 1	D-2/800'
:06				:36		CH - 47	D-3/1200'
:07				:37			
:07				:37			
:08		CH - 47	D-3/1200'	:38			
:08				:38			
:09				:38			
:09				:38			
:10		UH - 1	D-1/400'	:40		UH - 1	D-1/400'
:10				:40		CH - 47	D-3/1200'
:11		UH - 1	D-2/800'	:41		UH - 1	D-2/800'
:11				:41			
:12		CH - 47	D-3/1200'	:42			
:12				:42			
:13				:43			
:13				:43			
:14				:44		CH - 47	D-3/1200'
:14				:44			
:15		UH - 1	D-1/400'	:45		UH - 1	D-1/400'
:15				:45			
:16		UH - 1	D-2/800'	:46		UH - 1	D-2/800'
:16		CH - 47	D-3/1200'	:46			
:17				:47			
:17				:47			
:18				:48		CH - 47	D-3/1200'
:18				:48			
:19				:49			
:19				:49			
:20		UH - 1	D-1/400'	:50		UH - 1	D-1/400'
:20		CH - 47	D-3/1200'	:50			
:21		UH - 1	D-2/800'	:51		UH - 1	D-2/800'
:21				:51			
:22				:52		CH - 47	D-3/1200'
:22				:52			
:23				:53			
:23				:53			
:24		CH - 47	D-3/1200'	:54			
:24				:54			
:25		UH - 1	D-1/400'	:55		UH - 1	D-1/400'
:25				:55			
:26		UH - 1	D-2/800'	:56		UH - 1	D-2/800'
:26				:56		CH - 47	D-3/1200'
:27				:57			
:27				:57			
:28		CH - 47	D-3/1200'	:58			
:28				:58			
:29				:59			
:29				:59			

FIG. II-2 DEPARTURE CONTROL CHART - FIXED BASE - PLAN I-B



DEPARTURE CONTROL CHART ASSAULT BASE

UH-1 OPERATIONS				CH-47 OPERATIONS			
CLEARANCE ALTITUDE	AIRCRAFT IDENT.	SCHEDULED DEPARTURE TIME	ACTUAL DEPARTURE TIME	CLEARANCE ALTITUDE	AIRCRAFT IDENT.	SCHEDULED DEPARTURE TIME	ACTUAL DEPARTURE TIME
R-1/1600'				R-3/2400'			
R-2/2000'							
				R-3/2400'			
R-1/1600'							
R-2/2000'							
				R-3/2400'			
R-1/1600'							
R-2/2000'				R-3/2400'			
R-1/1600'							
R-2/2000'				R-3/2400'			
R-1/1600'				R-3/2400'			
R-2/2000'							
				R-3/2400'			
R-1/1600'							
R-2/2000'							
				R-3/2400'			
R-1/1600'							
R-2/2000'				R-3/2400'			
R-1/1600'				R-3/2400'			
R-2/2000'							
				R-3/2400'			
R-1/1600'							
R-2/2000'				R-3/2400'			
R-1/1600'				R-3/2400'			
R-2/2000'							

FIG. II-3 DEPARTURE CONTROL CHART - ASSAULT BASE - PLAN I-B

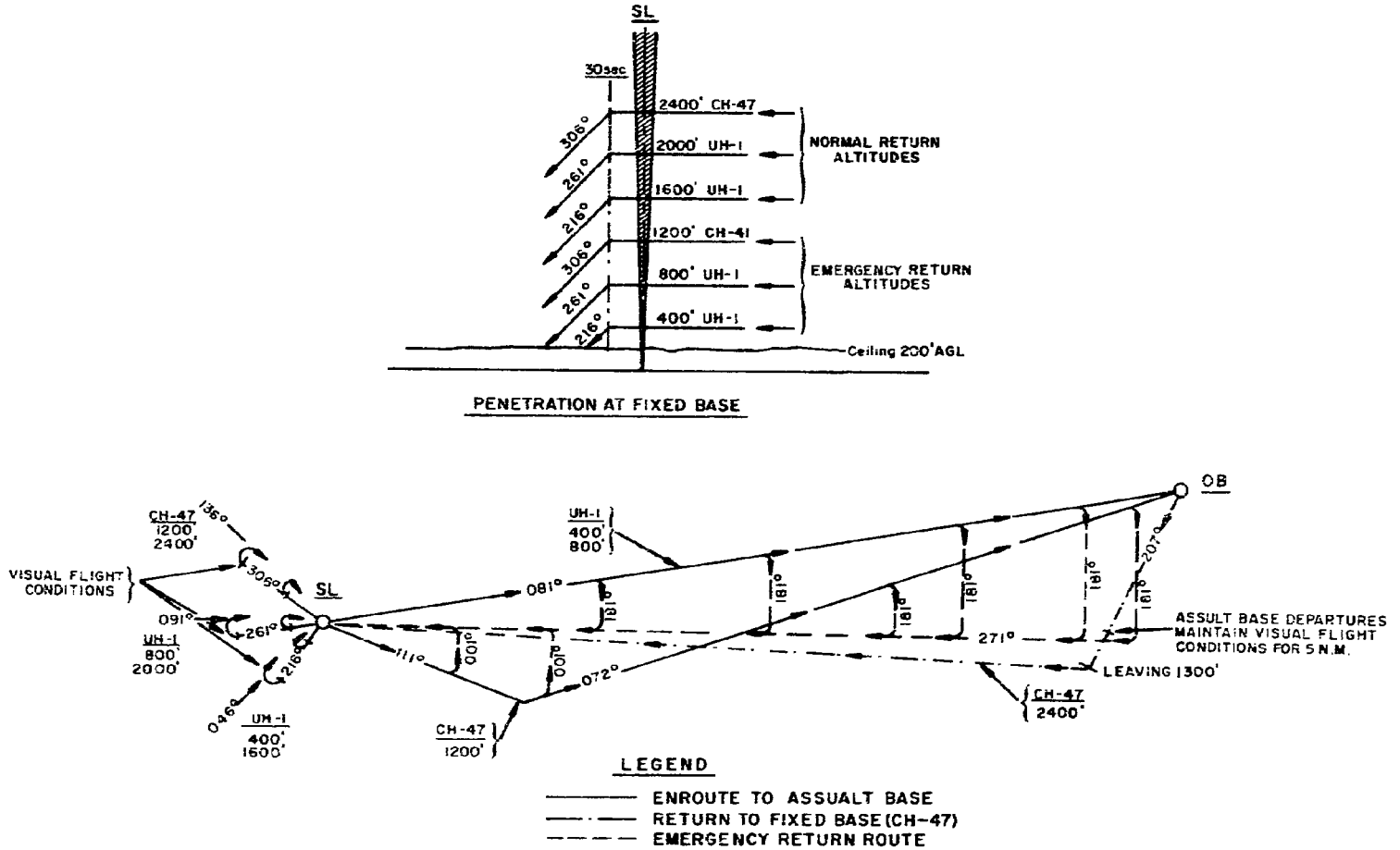


FIG. II-4 EMERGENCY RETURN AND PENETRATION PROCEDURE - PLAN I-B

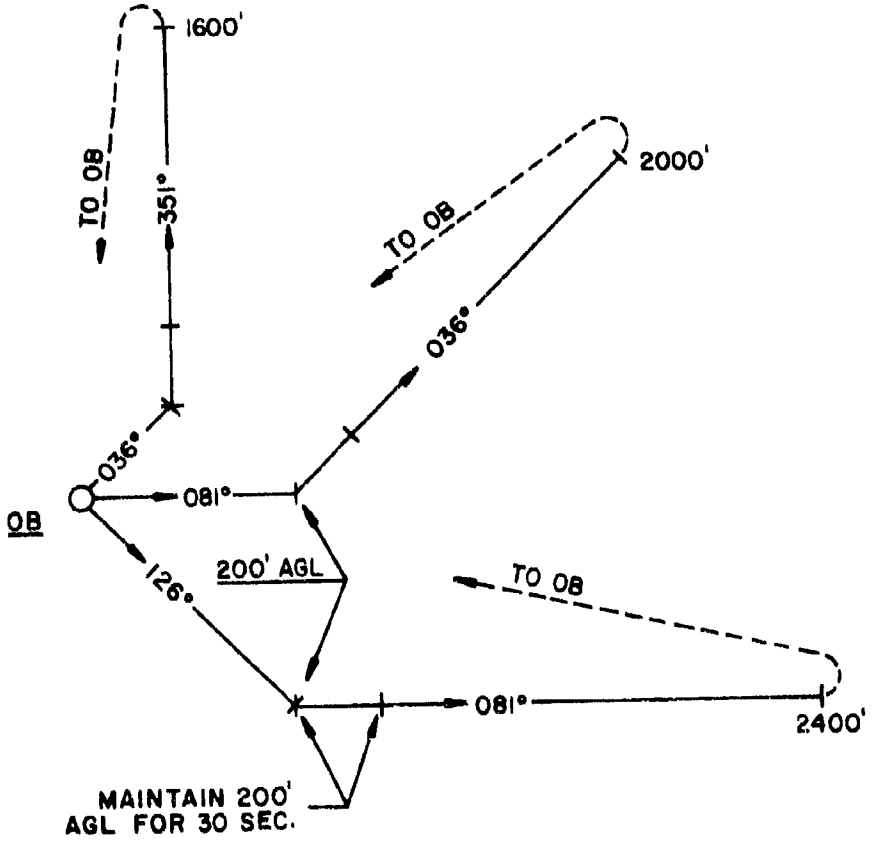


FIG. II-5 MISSED APPROACH PROCEDURE - PLAN I-B

APPENDIX III

PLAN II

General: This plan uses 6 altitudes from the fixed base to the assault base and 6 altitudes returning from the assault base to the fixed base for a total of 12 altitudes. These 12 altitudes range from the base altitude of 400 feet above ground level up to and including 4800 feet above ground level. This plan uses the highest altitudes of any of the plans tested. Using the UH-1 series helicopters with the 5-minute longitudinal separation, this plan gives a theoretical arrival rate of 72 aircraft per hour at the assault base.

Navigational facility requirements for this plan remain the same as in Plan I or I-B.

Departures from Fixed Base: Departure procedures from the fixed base (FIG. III-1) are the same as those used in Plan I-B. This plan is a like-type helicopter operation. The first 3 altitudes are assigned to the direct route between the fixed base NDB and the assault base NDB. The next 3 altitudes are assigned to the off-course route to the assault base NDB. This allows simultaneous departures with track separation from the fixed base NDB. Departures off the fixed base are controlled by the fixed base controller utilizing the Departure Control Chart-Fixed Base (FIG. III-2).

Penetration Procedure at Assault Base: Penetration procedures are identical to the procedures in Plan I-B. Because of the utilization of 6 altitudes, dual penetrations now become necessary in each of the three penetration legs (FIG. III-1).

Departures from the Assault Base: Departure routes and altitudes are shown in Figure III-1. Controllers at the assault base, control departures utilizing the Departure Control Chart - Assault Base (FIG. III-3).

This chart is divided, with all clearances and altitudes in one column being assigned one departure track and in the other column are clearances and altitudes assigned to the second departure track. In this manner, the controllers separate departures with regard to aircraft on individual tracks. Simultaneous departures are authorized between the aircraft on diverging tracks.

Penetration at the Fixed Base: Penetration procedures at the fixed base are identical with those at the assault base (FIG. III-1).

Emergency Return Procedure: Figure III-4 illustrates the full emergency return procedure for this plan indicating which altitudes are assigned to the various routes.

Controller Duties During Emergency Return Procedure:

Assault Base Controller -

1. Coordinate with the fixed base controller and advise that the emergency return procedure is to be initiated.

2. Stop all departures on the southwest departure track. If aircraft have departed on this track, the controller must ascertain their altitudes and assure that the last departure has left an altitude of at least 100 feet above the highest enroute altitude in use to the assault base prior to initiating the emergency return action.

3. Broadcast to all aircraft enroute from fixed base to assault base to execute the emergency return procedure.

Fixed Base Controller -

1. Stop all departures.

2. Ascertain that all departures have reached their assigned altitudes.

3. Advise the assault base controller that the emergency procedure may be initiated.

4. Broadcast to all aircraft enroute from the fixed base to assault base to execute the emergency return procedure. (Must be accomplished by the fixed base controller prior to or simultaneously with the assault base controller's broadcast).

Missed Approach: The missed approach procedure is shown in Figure III-5. Prior to arrival over the assault base NDB, the pilot must be given additional clearance. Procedures to be followed for return to fixed base are the same as those in the missed approach section of Plan I.

A second approach to the assault base is not practical. The first assigned missed approach altitude is 2800 feet AGL; this aircraft will travel a distance of 3 3/4 NM in penetration until reaching visual flight conditions. This distance will increase by 1/2 NM for each succeeding altitude until reaching the highest assigned missed approach altitude of

4800 feet AGL. The aircraft making a second approach from 4800 feet AGL, will travel a distance of at least 6 1/4 NM in penetration from the assault base NDB until reaching visual flight conditions. Terrain around the assault base, control complexity, or other factors make second approaches highly undesirable.

Controller Duties: Controllers follow the same procedures as outlined in Plan I with the exception of procedures outlined for second approaches.

Clearances: The following clearances are used in this plan:

A. Departure from Fixed Base:

D-20 Track 081° from the SL Rbn, climb to and maintain 400 feet. Track 036° from the OB Rbn, maintain 400 feet for 30 seconds then descend to visual flight conditions (200 feet). Upon reaching visual flight conditions, turn right to intercept a track of 226° to the Assault Base Rbn.

Missed Approach Procedure -

Turn left to a heading of 351°, maintain 200 feet for 30 seconds, then climb to 2800 feet. Upon reaching 2800 feet, turn left, proceed direct to the OB Rbn. Proceed as directed by the OB Controller.

D-21 Track 111° from the SL Rbn, climb to and maintain 1600 feet. Maintain track of 111° until intercepting a bearing of 252° from the OB Rbn. Track 072° to the OB Rbn. Track 036° from the OB Rbn maintain 1600 feet for 30 seconds, then descend to visual flight conditions (200 feet). Upon reaching visual flight conditions, turn right to intercept a track of 226° to the Assault Base Rbn.

Missed Approach Procedure -

Turn left to a heading of 351°, maintain 200 feet for 30 seconds, then climb to 3200 feet. Upon reaching 3200 feet, turn left, proceed to the OB Rbn. Proceed as directed by the OB Controller.

D-22 Track 081° from the SL Rbn, climb to and maintain 800 feet. Track 081° from the OB Rbn, maintain 800 feet for 30 seconds then descend to visual flight conditions (200 feet). Upon reaching visual flight conditions, turn right to intercept a track of 271° to the Assault Base Rbn.

Missed Approach Procedure -

Turn left to a heading of 036°, maintain 200 feet for 30 seconds, then climb to 3600 feet. Upon reaching 3600 feet, turn left, proceed direct to the OB Rbn. Proceed as directed by the OB Controller.

D-23 Track 111° from the SL Rbn, climb to and maintain 2000 feet. Maintain track of 111° until intercepting a bearing of 252° from the OB Rbn. Track 072° to the OB Rbn. Track 081° from the OB Rbn, maintain 2000 feet for 30 seconds, then descend to visual flight conditions (200 feet). Upon reaching visual flight conditions, turn right to intercept a track of 271° to the Assault Base Rbn.

Missed Approach Procedure -

Turn left to a heading of 036°, maintain 200 feet for 30 seconds, then climb to 4000 feet. Upon reaching 4000 feet, turn left, proceed direct to the OB Rbn. Proceed as directed by the OB Controller.

D-24 Track 081° from the SL Rbn, climb to and maintain 1200 feet. Track 126° from the OB Rbn, maintain 1200 feet for 30 seconds then descend to visual flight conditions (200 feet). Upon reaching visual flight conditions, turn right to intercept a track of 316° to the Assault Base Rbn.

Missed Approach Procedure -

Turn left to a heading of 081°, maintain 200 feet for 30 seconds, then climb to 4400 feet. Upon reaching 4400 feet, turn left, proceed direct to the OB Rbn. Proceed as directed by the OB Controller.

D-25 Track 111° from the SL Rbn, climb to and maintain 2400 feet. Maintain track of 111° until intercepting a

bearing of 252° from the OB Rbn. Track 072° to the OB Rbn. Track 126° from the OB Rbn maintain 2400 feet for 30 seconds, then descend to visual flight conditions (200 feet). Upon reaching visual flight conditions, turn right to intercept a track of 316° to the Assault Base Rbn.

Missed Approach Procedure -

Turn left to a heading of 081°, maintain 200 feet for 30 seconds, then climb to 4800 feet. Upon reaching 4800 feet, turn left, proceed direct to the OB Rbn. Proceed as directed by the OB Controller.

B. Departure from Assault Base:

R-20 Track 306° from the OB Rbn, maintain visual flight conditions at or below 200 feet for 3 min. 45 sec. after passing the Rbn, then climb to and maintain 2800 feet. Upon leaving 2500 feet, proceed direct to the SL Rbn. Track 216° from the SL Rbn maintaining 2800 feet for 30 seconds, then descend to visual flight conditions (200 feet). Upon reaching visual flight conditions turn right to intercept a track of 046° to the Fixed Base Rbn.

R-21 Track 207° from the OB Rbn, maintain visual flight conditions at or below 200 feet for 3 min. 45 sec. after passing the Rbn, then climb to and maintain 4000 feet. Upon leaving 2500 feet, proceed direct to the SL Rbn. Track 216° from the SL Rbn maintaining 4000 feet for 30 seconds, then descend to visual flight conditions (200 feet). Upon reaching visual conditions turn right to intercept a track of 046° to the Fixed Base Rbn.

R-22 Track 306° from the OB Rbn, maintain visual flight conditions at or below 200 feet for 3 min. 45 seconds after passing the Rbn, then climb to and maintain 3200 feet. Upon leaving 2500 feet, proceed direct to the SL Rbn. Track 261° from the SL Rbn maintaining 3200 feet for 30 seconds, then descend to visual flight conditions (200 feet). Upon reaching visual flight conditions turn right to intercept a track of 091° to the Fixed Base Rbn.

R-23 Track 207° from the OB Rbn, maintain visual flight conditions at or below 200 feet for 3 min. 45 seconds after passing the Rbn, then climb to and maintain 4400 feet. Upon leaving 2500 feet, proceed direct to the SL Rbn. Track 261° from the SL Rbn maintaining 4400 feet for 30 seconds, then descend to visual flight conditions (200 feet). Upon reaching visual flight conditions turn right to intercept a track of 091° to the Fixed Base Rbn.

R-24 Track 306° from the OB Rbn, maintain visual flight conditions at or below 200 feet for 3 min. 45 seconds after passing the Rbn, then climb to and maintain 3600 feet. Upon leaving 2500 feet, proceed direct to the SL Rbn. Track 306° from the SL Rbn maintaining 3600 feet for 30 seconds, then descend to visual flight conditions (200 feet). Upon reaching visual flight conditions, turn right to intercept a track of 136° to the Fixed Base Rbn.

R-25 Track 207° from the OB Rbn, maintain visual flight conditions at or below 200 feet for 3 min. 45 seconds after passing the Rbn, then climb to and maintain 4800 feet. Upon leaving 2500 feet, proceed direct to the SL Rbn. Track 306° from the SL Rbn maintaining 4800 feet for 30 seconds, then descend to visual flight conditions (200 feet). Upon reaching visual flight conditions turn right to intercept a track of 136° to the Fixed Base Rbn.

C. Emergency Return Procedure:

Intercept 091° bearing from SL Rbn. Track 271° to the SL Rbn. Maintain assigned altitude.

Acft. South of 091° bearing from SL Rbn -

Turn left heading 001° to intercept.

Acft. North of 091° bearing from SL Rbn -

Turn right heading 181° to intercept.

See Figure III-4 for illustration of the penetration procedures when making an emergency return to fixed base.

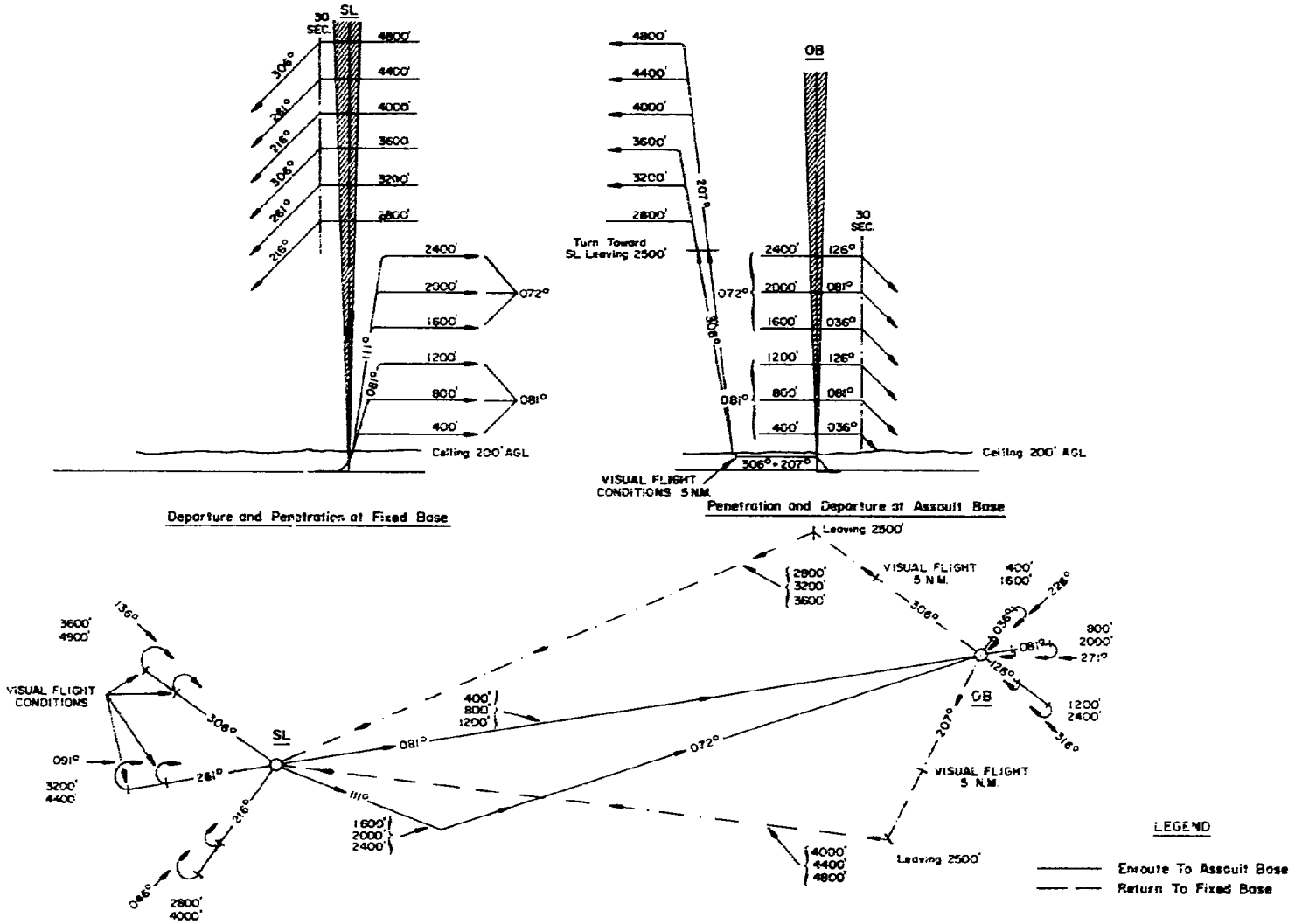


FIG. III-1 DEPARTURE, PENETRATION PROCEDURES, AND TRAFFIC FLOW DIAGRAM - PLAN II

DEPARTURE CONTROL CHART FIXED BASE

SCHEDULED DEPARTURE TIME	ACFT. IDENT.	TYPE ACFT.	CLEARANCE ALTITUDE	SCHEDULED DEPARTURE	ACFT. IDENT.	TYPE ACFT.	CLEARANCE ALTITUDE
:00		UH - 1	D-20/400'	:30		UH - 1	D-20/400'
:00		UH - 1	D-21/1600'	:30		UH - 1	D-21/1600'
:01		UH - 1	D-22/800'	:31		UH - 1	D-22/800'
:01		UH - 1	D-23/2000'	:31		UH - 1	D-23/2000'
:02		UH - 1	D-24/1200'	:32		UH - 1	D-24/1200'
:02		UH - 1	D-25/2400'	:32		UH - 1	D-25/2400'
:03				:33			
:03				:33			
:04				:34			
:04				:34			
:05		UH - 1	D-20/400'	:35		UH - 1	D-20/400'
:05		UH - 1	D-21/1600'	:35		UH - 1	D-21/1600'
:06		UH - 1	D-22/800'	:36		UH - 1	D-22/800'
:06		UH - 1	D-23/2000'	:36		UH - 1	D-23/2000'
:07		UH - 1	D-24/1200'	:37		UH - 1	D-24/1200'
:07		UH - 1	D-25/2400'	:37		UH - 1	D-25/2400'
:08				:38			
:08				:38			
:09				:39			
:09				:39			
:10		UH - 1	D-20/400'	:40		UH - 1	D-20/400'
:10		UH - 1	D-21/1600'	:40		UH - 1	D-21/1600'
:11		UH - 1	D-22/800'	:41		UH - 1	D-22/800'
:11		UH - 1	D-23/2000'	:41		UH - 1	D-23/2000'
:12		UH - 1	D-24/1200'	:42		UH - 1	D-24/1200'
:12		UH - 1	D-25/2400'	:42		UH - 1	D-25/2400'
:13				:43			
:13				:43			
:14				:44			
:14				:44			
:15		UH - 1	D-20/400'	:45		UH - 1	D-20/400'
:15		UH - 1	D-21/1600'	:45		UH - 1	D-21/1600'
:16		UH - 1	D-22/800'	:46		UH - 1	D-22/800'
:16		UH - 1	D-23/2000'	:46		UH - 1	D-23/2000'
:17		UH - 1	D-24/1200'	:47		UH - 1	D-24/1200'
:17		UH - 1	D-25/2400'	:47		UH - 1	D-25/2400'
:18				:48			
:18				:48			
:19				:49			
:19				:49			
:20		UH - 1	D-20/400'	:50		UH - 1	D-20/400'
:20		UH - 1	D-21/1600'	:50		UH - 1	D-21/1600'
:21		UH - 1	D-22/800'	:51		UH - 1	D-22/800'
:21		UH - 1	D-23/2000'	:51		UH - 1	D-23/2000'
:22		UH - 1	D-24/1200'	:52		UH - 1	D-24/1200'
:22		UH - 1	D-25/2400'	:52		UH - 1	D-25/2400'
:23				:53			
:23				:53			
:24				:54			
:24				:54			
:25		UH - 1	D-20/400'	:55		UH - 1	D-20/400'
:25		UH - 1	D-21/1600'	:55		UH - 1	D-21/1600'
:26		UH - 1	D-22/800'	:56		UH - 1	D-22/800'
:26		UH - 1	D-23/2000'	:56		UH - 1	D-23/2000'
		UH - 1	D-24/1200'	:57		UH - 1	D-24/1200'
		UH - 1	D-25/2400'	:57		UH - 1	D-25/2400'
:28				:58			
:28				:58			
:29				:59			
:29				:59			

FIG. III-2 DEPARTURE CONTROL CHART - FIXED BASE - PLAN II

DEPARTURE CONTROL CHART ASSAULT BASE							
UH-1 OPERATIONS							
CLEARANCE ALTITUDE	AIRCRAFT IDENT.	SCHEDULED DEPARTURE TIME	ACTUAL DEPARTURE TIME	CLEARANCE ALTITUDE	AIRCRAFT IDENT.	SCHEDULED DEPARTURE TIME	ACTUAL DEPARTURE TIME
R-20/2800'				R-21/4000'			
R-22/3200'				R-23/4400'			
R-24/3600'				R-25/4800'			
R-20/2800'				R-21/4000'			
R-22/3200'				R-23/4400'			
R-24/3600'				R-25/4800'			
R-20/2800'				R-21/4000'			
R-22/3200'				R-23/4400'			
R-24/3600'				R-25/4800'			
R-20/2800'				R-21/4000'			
R-22/3200'				R-23/4400'			
R-24/3600'				R-25/4800'			
R-20/2800'				R-21/4000'			
R-22/3200'				R-23/4400'			
R-24/3600'				R-25/4800'			
R-20/2800'				R-21/4000'			
R-22/3200'				R-23/4400'			
R-24/3600'				R-25/4800'			
R-20/2800'				R-21/4000'			
R-22/3200'				R-23/4400'			
R-24/3600'				R-25/4800'			
R-20/2800'				R-21/4000'			
R-22/3200'				R-23/4400'			
R-24/3600'				R-25/4800'			
R-20/2800'				R-21/4000'			
R-22/3200'				R-23/4400'			
R-24/3600'				R-25/4800'			
R-20/2800'				R-21/4000'			
R-22/3200'				R-23/4400'			
R-24/3600'				R-25/4800'			
R-20/2800'				R-21/4000'			
R-22/3200'				R-23/4400'			
R-24/3600'				R-25/4800'			
R-20/2800'				R-21/4000'			
R-22/3200'				R-23/4400'			
R-24/3600'				R-25/4800'			

FIG. III-3 DEPARTURE CONTROL CHART - ASSAULT BASE - PLAN II

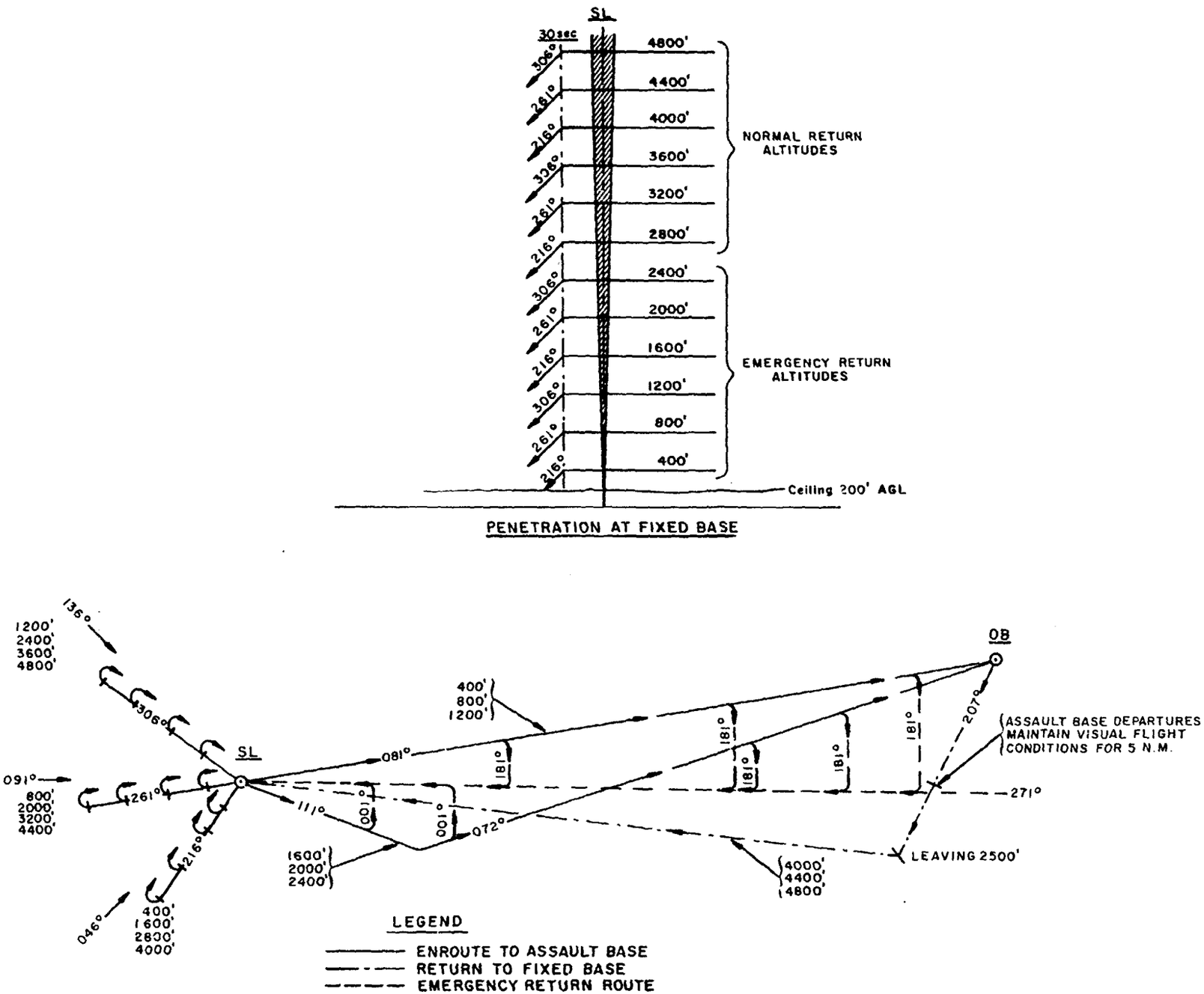


FIG. III-4 EMERGENCY RETURN AND PENETRATION PROCEDURE - PLAN II

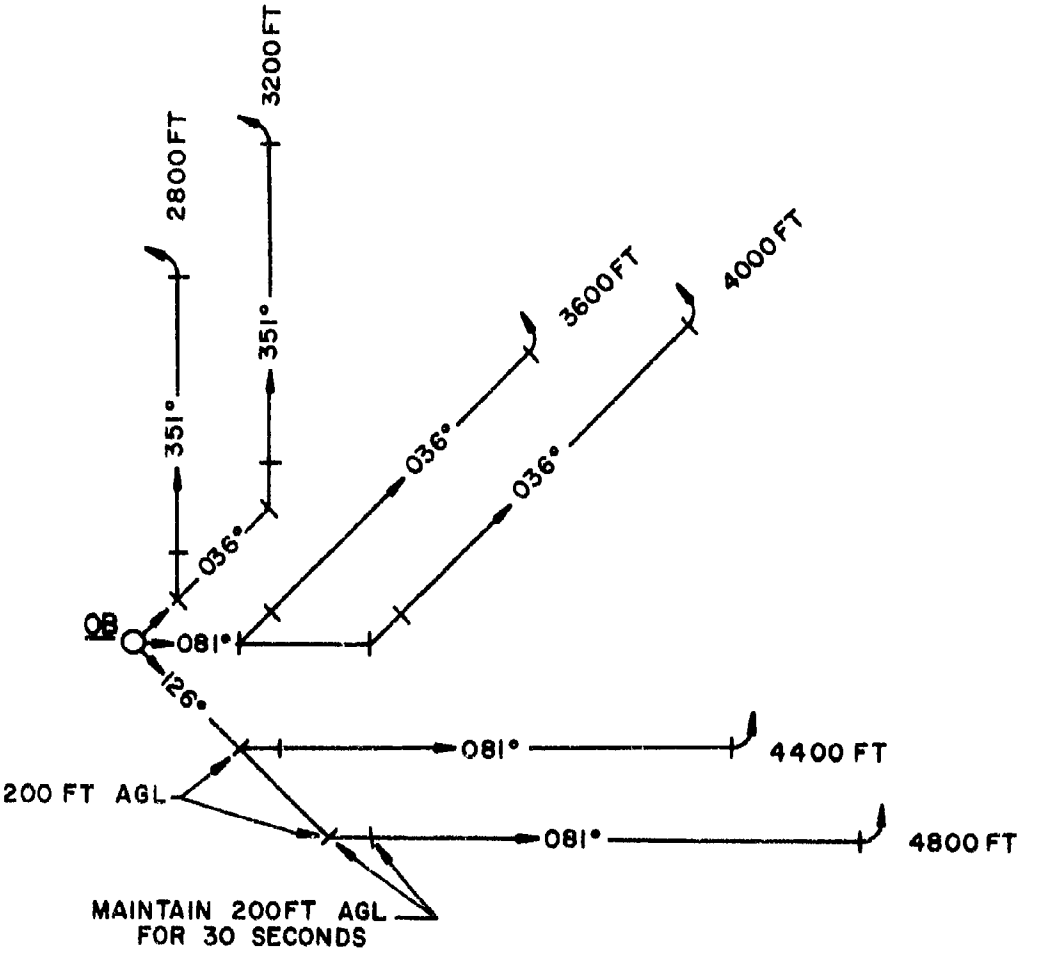


FIG. III-5 MISSED APPROACH PROCEDURE - PLANS II, III, AND IV

APPENDIX IV

PLAN II-B

General: Plan II-B is a modification to Plan II to incorporate the mixing of helicopter types. Navigational requirements for this plan are a single NDB at the fixed base and a portable NDB at the assault base. Four altitudes are assigned to UH-1 type helicopters and 2 altitudes are assigned to CH-47 type helicopters.

The two altitudes assigned the CH-47 Helicopters are on the off course route from the fixed base to the assault base, while the altitudes assigned for use by the UH-1 Helicopters are on the direct route (FIG. IV-1). The four altitudes assigned to the UH-1 Helicopters give a movement rate of 48 UH-1 arrivals per hour and the two altitudes assigned to the CH-47's give a movement rate of 30 CH-47 arrivals per hour, for a theoretical arrival rate at the assault base of 78 helicopters per hour.

This plan is flexible in that additional altitudes could be assigned to the CH-47 type helicopters. In doing this, however, adjustments must be made in routes and a greater time restriction must be added on some of the penetration legs. The plan is so designed that all CH-47 type helicopters are segregated into a single penetration leg both at the assault base and fixed base.

Departures from Fixed Base: Departures are released from the fixed base in accordance with the Departure Control Chart-Fixed Base (FIG. IV-2). CH-47 Helicopters are assigned the off course climb to altitudes and are released simultaneous with the UH-1's (FIG. IV-1).

Penetration Procedure at Assault Base: Except for the segregation of helicopter types on a penetration leg, the basic penetration procedure is retained in this plan (FIG. IV-1).

Departures from the Assault Base: Departure procedures are identical to those in Plans I-B and II, using the same two departure tracks and procedures. Two altitudes are assigned the CH-47 type helicopters on the southwesterly departure route and four aititudes are assigned to the UH-1 type helicopters on the northwesterly departure route (FIG. IV-1).

CH-47 and UH-1 Helicopters depart simultaneously off the assault base. Controllers release aircraft according to the Departure Control Chart-Assault Base (FIG. IV-3), which was divided into two sections, one for the UH-1 operations and one for the CH-47 operations.

Penetrations at the Fixed Base: The same procedures are used for penetrations at the fixed base as are used in Plan II (FIG. IV-1). Because of the segregation of helicopter types, the simplicity is maintained.

Emergency Return Procedures: Figure IV-4 illustrates the full emergency return procedure and penetration at the fixed base.

Controller Duties During Emergency Return Procedure:

Assault Base Controller - Same as those duties listed in Plan II.

Fixed Base Controller - Same as those duties listed in Plan II.

Missed Approach Procedures: Missed approach procedures are shown in Figure IV-5. Upon reaching the missed approach altitude, a left turn is made direct to the assault base NDB. Prior to arrival over the assault base NDB, the pilot must be given additional clearance. As in Plan II, second approaches to the assault base are not practical. A change in missed approach altitude assignments is made in this plan (FIG. IV-5). The altitude 3600 feet AGL is deleted and the altitude of 6000 feet AGL is substituted. This change in altitude assignments is made in order to maintain full segregation of helicopter types in the penetration legs at the fixed base and also to maintain the 1200 feet vertical separation between aircraft in the penetration legs. In doing this, the controller workload is kept to a minimum and simplicity is maintained.

Controller Duties During Missed Approaches:

Controller duties are the same as those outlined in Plan 1.

Clearances: The following clearances are used in this plan:

A. Departure from Fixed Base

D-20 Track 081° from the SL Rbn, climb to and maintain 400 feet. Track 036° from the OB Rbn, maintain 400 feet for 30 seconds, then descend to visual flight conditions (200 feet). Upon reaching visual flight conditions turn right to intercept a track of 226° to the Assault Base Rbn.

Missed Approach Procedure -

Turn left to a heading of 351°, maintain 200 feet for 30 seconds, then climb to 2800 feet. Upon reaching 2800 feet, turn left, proceed direct to the OB Rbn. Proceed as directed by the OB Controller.

D-21 Track 081° from the SL Rbn, climb to and maintain 800 feet. Track 081° from the OB Rbn, maintain 800 feet for 30 seconds, then descend to visual flight conditions (200 feet). Upon reaching visual flight conditions turn right to intercept a track of 271° to the Assault Base Rbn.

Missed Approach Procedure -

Turn left to a heading of 036°, maintain 200 feet for 30 seconds, then climb to 4000 feet. Upon reaching 4000 feet, turn left, proceed direct to the OB Rbn. Proceed as directed by the OB Controller.

D-22 Track 111° from the SL Rbn, climb to and maintain 1200 feet. Maintain track of 111° until intercepting a track of 072° to the OB Rbn. Track 126° from the OB Rbn, maintain 1200 feet for 30 seconds, then descend to visual flight conditions (200 feet). Upon reaching visual flight conditions, turn right to intercept a track of 316° to the Assault Base Rbn.

Missed Approach Procedure -

Turn left to a heading of 081° maintain 200 feet for 30 seconds, then climb to 4800 feet. Upon reaching

4800 feet, turn left, proceed direct to the OB Rbn. Proceed as directed by the OB Controller.

D-23 Track 081° from the SL Rbn, climb to and maintain 1600 feet. Track 036° from the OB Rbn, maintain 1600 feet for 30 seconds, then descend to visual flight conditions (200 feet). Upon reaching visual flight conditions, turn right to intercept a track of 226° to the Assault Base Rbn.

Missed Approach Procedure -

Turn left to a heading of 351°, maintain 200 feet for 30 seconds, then climb to 3200 feet. Upon reaching 3200 feet, turn left, proceed direct to the OB Rbn. Proceed as directed by the OB Controller.

D-24 Track 081° from the SL Rbn, climb to and maintain 2000 feet. Track 081° from the OB Rbn, maintain 2000 feet for 30 seconds, then descend to visual flight conditions (200 feet). Upon reaching visual flight conditions, turn right to intercept a track of 271° to the Assault Base Rbn.

Missed Approach Procedure -

Turn left to a heading of 036°, maintain 200 feet for 30 seconds, then climb to 4400 feet. Upon reaching 4400 feet, turn left, proceed direct to the OB Rbn. Proceed as directed by the OB Controller.

D-25 Track 111° from the SL Rbn, climb to and maintain 2400 feet. Track 111° until intercepting a track of 072° to the OB Rbn. Track 126° from the OB Rbn, maintain 2400 feet for 30 seconds, then descend to visual flight conditions (200 feet). Upon reaching visual flight conditions, turn right to intercept a track of 316° to the Assault Base Rbn.

Missed Approach Procedure -

Turn left to a heading of 081°, maintain 200 feet for 30 seconds, then climb to 6000 feet. Upon reaching 6000 feet, turn left, proceed direct to the OB Rbn. Proceed as directed by the OB Controller.

B. Departure from Assault Base:

R-20 Track 306° from the OB Rbn, maintain visual flight conditions at or below 200 feet for 3 min. 45 seconds, then climb to and maintain 2800 feet. Upon leaving 2500 feet, proceed direct to the SL Rbn. Track 216° from the SL Rbn, maintain 2800 feet for 30 seconds then descend to visual flight conditions (200 feet). Upon reaching visual flight conditions, turn right to intercept a track of 046° to the Fixed Base Rbn.

R-21 Track 306° from the OB Rbn, maintain visual flight conditions at or below 200 feet for 3 min. 45 seconds then climb to and maintain 3200 feet. Upon leaving 2500 feet, proceed direct to the SL Rbn. Track 261° from the SL Rbn maintain 3200 feet for 30 seconds then descend to visual flight conditions (200 feet). Upon reaching visual flight conditions, turn right to intercept a track of 091° to the Fixed Base Rbn.

R-22 Track 207° from the OB Rbn, maintain visual flight conditions at or below 200 feet for 2 min. 45 seconds, then climb to and maintain 3600 feet. Upon leaving 2500 feet, proceed direct to the SL Rbn. Track 306° from the SL Rbn, maintain 3600 feet for 30 seconds, then descend to visual flight conditions (200 feet). Upon reaching visual flight conditions, turn right to intercept a track of 136° to the Fixed Base Rbn.

R-23 Track 306° from the OB Rbn, maintain visual flight conditions at or below 200 feet for 3 min. 45 seconds then climb to and maintain 4000 feet. Upon leaving 2500 feet, proceed direct to the SL Rbn. Track 216° from the SL Rbn, maintain 4000 feet for 30 seconds, then descend to visual flight conditions (200 feet). Upon reaching visual flight conditions, turn right to intercept a track of 046° to the Fixed Base Rbn.

R-24 Track 306° from the OB Rbn, maintain visual flight conditions at or below 200 feet for 3 min. 45 seconds after passing the Rbn, then climb to and maintain 4400 feet. Upon leaving 2500 feet, proceed direct to the SL Rbn. Track 261° from the SL Rbn, maintain 4400 feet for 30 seconds, then descend to visual flight conditions (200 feet). Upon reaching visual flight conditions, turn right to intercept a track of 091° to the Fixed Base Rbn.

R-25 Track 207° from the OB Rbn, maintain visual flight conditions at or below 200 feet for 2 min. 45 seconds after passing the Rbn, then climb to and maintain 4800 feet. Upon leaving 2500 feet, proceed direct to the SL Rbn. Track 306° from the SL Rbn, maintain 4800 feet for 30 seconds, then descend to visual flight conditions (200 feet). Upon reaching visual flight conditions, turn right to intercept a track of 136° to the Fixed Base Rbn.

R-26 (To be used only for missed approach of CH-47 aircraft on D-25 clearance). Track 261° from the OB Rbn, maintain 6000 feet. Track 306° from the SL Rbn, maintain 6000 feet for 30 seconds then descend to visual flight conditions (200 feet). Upon reaching visual flight conditions turn right to intercept a track 136° to the Fixed Base Rbn.

C. Emergency Return Procedure:

Intercept 091° bearing from SL Rbn. Track 271° to the SL Rbn. Maintain assigned altitude.

Acft. South of 091° bearing from SL Rbn.

Turn left heading 001° to intercept.

Acft. North of 091° bearing from SL Rbn.

Turn right heading 181° to intercept.

See Figure IV-4 for illustration of the penetration procedures when making an emergency return to fixed base.

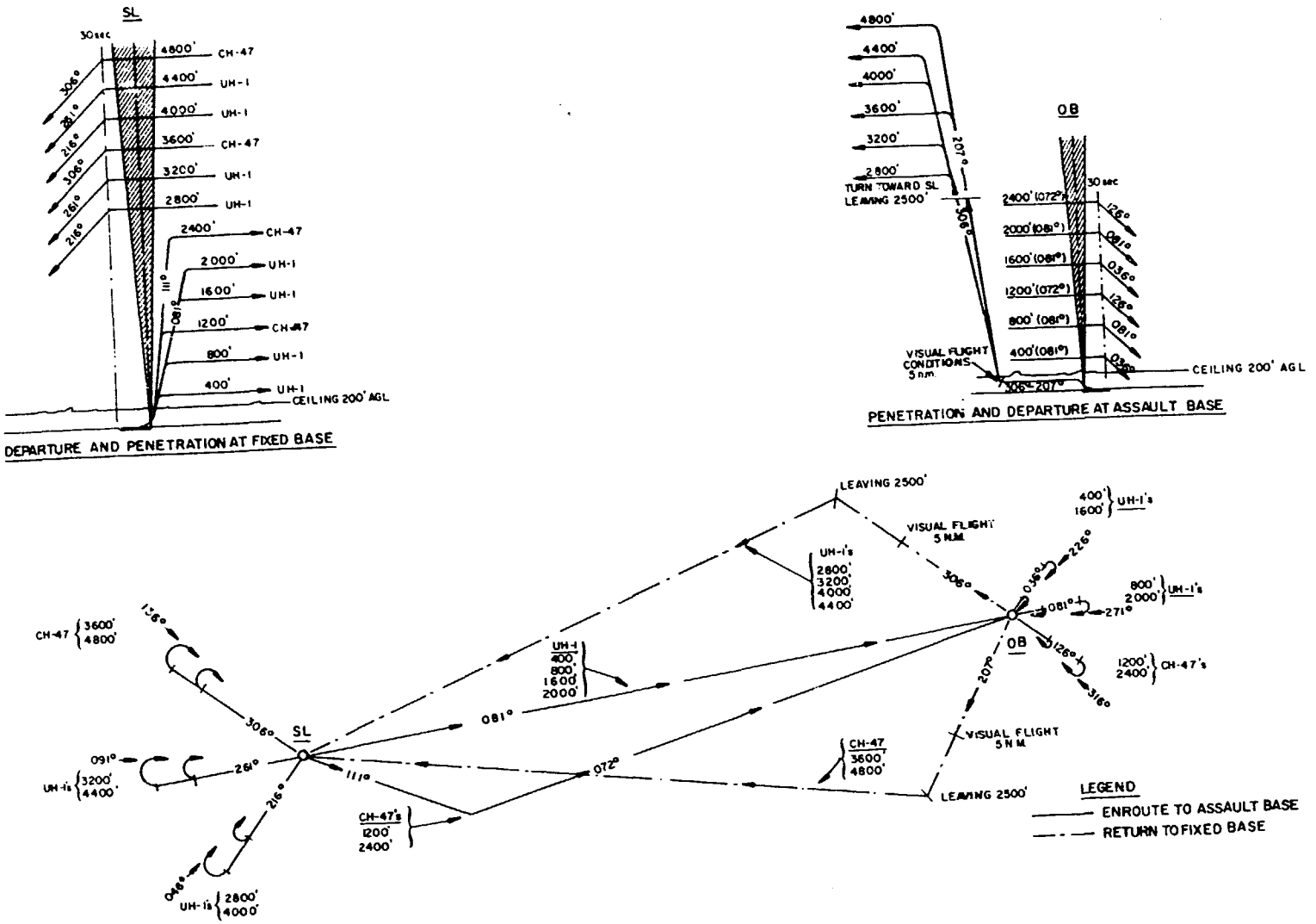


FIG. IV-1 DEPARTURE, PENETRATION PROCEDURES, AND TRAFFIC FLOW DIAGRAM - PLAN II-B

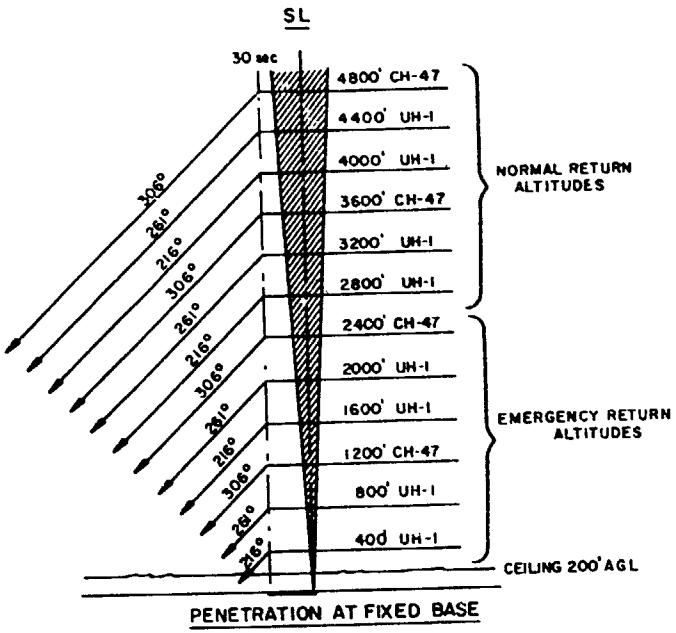
DEPARTURE CONTROL CHART FIXED BASE

SCHEDULED DEPARTURE TIME	ACFT. IDENT.	TYPE ACFT.	CLEARANCE ALTITUDE	SCHEDULED DEPARTURE TIME	ACFT. IDENT.	TYPE ACFT.	CLEARANCE ALTITUDE
:00		UH - 1	D-20/400'	:30		UH - 1	D-20/400'
:00		CH - 47	D-22/1200'	:30			
:01		UH - 1	D-21/800'	:31		UH - 1	D-21/800'
:01		CH - 47	D-25/2400'	:31			
:02		UH - 1	D-23/1600'	:32		UH - 1	D-23/1600'
:02				:32		CH - 47	D-22/1200'
:03		UH - 1	D-24/2000'	:33		UH - 1	D-24/2000'
:03				:33		CH - 47	D-25/2400'
:04		CH - 47	D-22/1200'	:34			
:04				:34			
:05		UH - 1	D-20/400'	:35		UH - 1	D-20/400'
:05		CH - 47	D-25/2400'	:35			
:06		UH - 1	D-21/800'	:36		UH - 1	D-21/800'
:06				:36		CH - 47	D-22/1200'
:07		UH - 1	D-23/1600'	:37		UH - 1	D-23/1600'
:07				:37		CH - 47	D-25/2400'
:08		UH - 1	D-24/2000'	:38		UH - 1	D-24/2000'
:08		CH - 47	D-22/1200'	:38			
:09		CH - 47	D-25/2400'	:39			
:09				:39			
:10		UH - 1	D-20/400'	:40		UH - 1	D-20/400'
:10				:40		CH - 47	D-22/1200'
:11		UH - 1	D-21/800'	:41		UH - 1	D-21/800'
:11				:41		CH - 47	D-25/2400'
:12		UH - 1	D-23/1600'	:42		UH - 1	D-23/1600'
:12		CH - 47	D-22/1200'	:42			
:13		UH - 1	D-24/2000'	:43		UH - 1	D-24/2000'
:13		CH - 47	D-25/2400'	:43			
:14				:44		CH - 47	D-22/1200'
:14				:44			
:15		UH - 1	D-20/400'	:45		UH - 1	D-20/400'
:15				:45		CH - 47	D-25/2400'
:16		UH - 1	D-21/800'	:46		UH - 1	D-21/800'
:16		CH - 47	D-22/1200'	:46			
:17		UH - 1	D-23/1600'	:47		UH - 1	D-23/1600'
:17		CH - 47	D-25/2400'	:47			
:18		UH - 1	D-24/2000'	:48		UH - 1	D-24/2000'
:18				:48		CH - 47	D-22/1200'
:19				:49		CH - 47	D-25/2400'
:19				:49			
:20		UH - 1	D-20/400'	:50		UH - 1	D-20/400'
:20		CH - 47	D-22/1200'	:50			
:21		UH - 1	D-21/800'	:51		UH - 1	D-21/800'
:21		CH - 47	D-25/2400'	:51			
:22		UH - 1	D-23/1600'	:52		UH - 1	D-23/1600'
:22				:52		CH - 47	D-22/1200'
:23		UH - 1	D-24/2000'	:53		UH - 1	D-24/2000'
:23				:53		CH - 47	D-25/2400'
:24		CH - 47	D-22/1200'	:54			
:24				:54			
:25		UH - 1	D-20/400'	:55		UH - 1	D-20/400'
:25		CH - 47	D-25/2400'	:55			
:26		UH - 1	D-21/800'	:56		UH - 1	D-21/800'
:26				:56		CH - 47	D-22/1200'
:27		UH - 1	D-23/1600'	:57		UH - 1	D-23/1600'
:27				:57		CH - 47	D-25/2400'
:28		UH - 1	D-24/2000'	:58		UH - 1	D-24/2000'
:28		CH - 47	D-22/1200'	:58			
:29		CH - 47	D-25/2400'	:59			
:29				:59			

FIG. IV-2 DEPARTURE CONTROL CHART - FIXED BASE - PLAN II-B

DEPARTURE CONTROL CHART ASSAULT BASE							
UH-1 OPERATIONS				CH-47 OPERATIONS			
CLEARANCE ALTITUDE	AIRCRAFT IDENT.	SCHEDULED DEPARTURE TIME	ACTUAL DEPARTURE TIME	CLEARANCE ALTITUDE	AIRCRAFT IDENT.	SCHEDULED DEPARTURE TIME	ACTUAL DEPARTURE TIME
R-20/2800'				R-22/3600'			
R-21/3200'				R-25/4800'			
R-23/4000'							
R-24/4400'							
				R-22/3600'			
R-20/2800'				R-25/4800'			
R-21/3200'							
R-23/4000'							
R-24/4400'				R-22/3600'			
				R-25/4800'			
R-20/2800'							
R-21/3200'							
R-23/4000'				R-22/3600'			
R-24/4400'				R-25/4800'			
R-20/2800'							
R-21/3200'				R-22/3600'			
R-23/4000'				R-25/4800'			
R-24/4400'							
R-20/2800'				R-22/3600'			
R-21/3200'				R-25/4800'			
R-23/4000'							
R-24/4400'							
				R-22/3600'			
R-20/2800'				R-25/4800'			
R-21/3200'							
R-23/4000'							
R-24/4400'				R-22/3600'			
				R-25/4800'			
R-20/2800'							
R-21/3200'							
R-23/4000'				R-22/3600'			
R-24/4400'				R-25/4800'			
R-20/2800'				R-22/3600'			
R-21/3200'				R-25/4800'			
R-23/4000'							
R-24/4400'							
R-20/2800'				R-22/3600'			
R-21/3200'				R-25/4800'			
R-23/4000'							
R-24/4400'							
				R-22/3600'			
R-20/2800'				R-25/4800'			
R-21/3200'							
R-23/4000'							
R-24/4400'							
				R-22/3600'			
R-20/2800'				R-25/4800'			
R-21/3200'							
R-23/4000'				R-22/3600'			
R-24/4400'				R-25/4800'			
R-20/2800'							
R-21/3200'				R-22/3600'			
R-23/4000'				R-25/4800'			
R-24/4400'							

FIG. IV-3 DEPARTURE CONTROL CHART - ASSAULT BASE - PLAN II-B



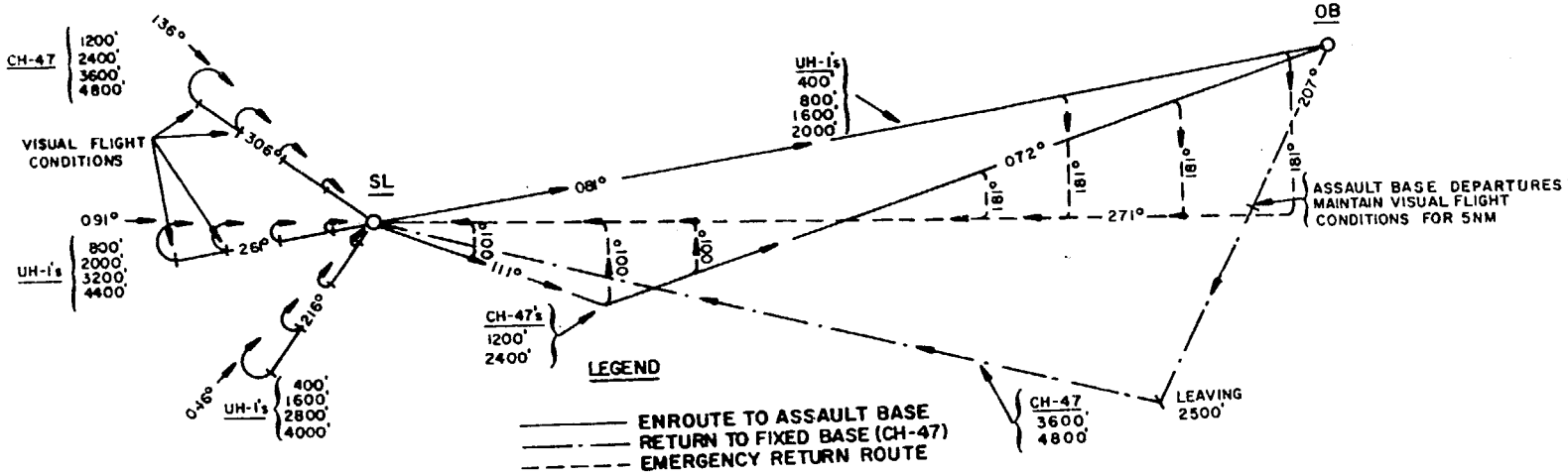


FIG. IV-4 EMERGENCY RETURN AND PENETRATION PROCEDURE - PLAN II-B

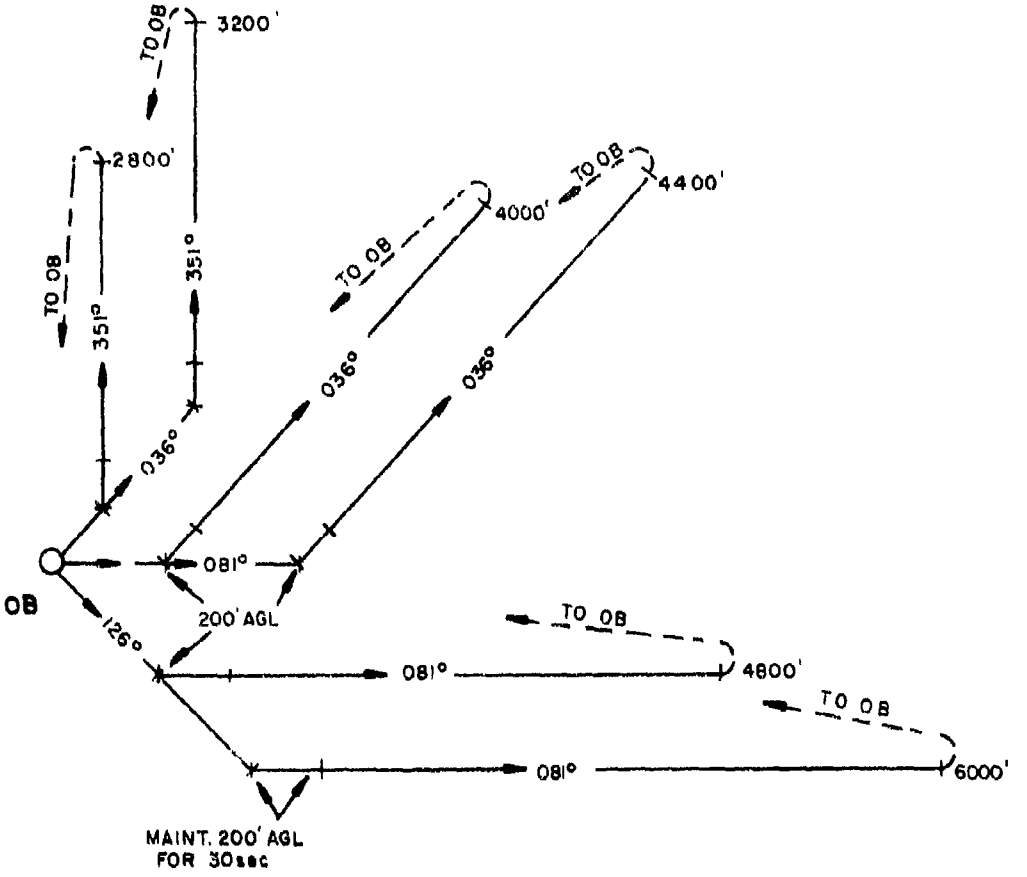


FIG. IV-5 MISSED APPROACH PROCEDURE - PLAN II-B

APPENDIX V

PLAN III

General: An additional nondirectional radio beacon at the fixed base is used in this plan making possible a significant reduction in altitude requirement. This plan can be used in dispatching aircraft from two marshalling areas, or from one fixed base.

The unique feature in this plan is the fact that aircraft returning from the assault base utilize the same altitudes as the aircraft enroute to the assault base. This is accomplished by the establishment of multiple routes (FIG. V-1).

Six altitudes are utilized, the highest altitude being 2400 feet AGL. The plan will accept a mixture of helicopter types.

The operation of departures off the "JH" NDB to the assault base and arrivals returning to the fixed base via the "JH" NDB, has an inherent restriction. The enroute altitudes between the "JH" and "MA" NDB are higher than the altitudes used on the return route. In a continuing operation, wherein aircraft are returning to the "JH" NDB while there are still aircraft for departure from "JH", a shut off of departures from "JH" is necessary as arriving aircraft become pertinent opposite direction traffic. The limitation adversely affects the capacity of this plan. It can be theorized that for a period of at least 30 minutes, this plan is capable of a movement rate of approximately 36 helicopters, and has an advantage in that the altitudes for the return flight are no higher than the outbound altitudes.

Departure from Fixed Base: The fixed base is located approximately midway between the two NDB's. Departures are marshalled on the hypothetical airport according to their departure route. This allows an unobstructed departure flow from the fixed base and eliminates any crossing of paths. Departures are controlled according to the Departure Control Chart-Fixed Base (FIG. V-2). The proper marshalling of aircraft is an important detail.

Penetration Procedure at Assault Base: Penetration procedures are shown in Figure V-1. If CH-47 type helicopters are substituted into the plan, the penetration procedures would be identical to those in Plan II-B.

Departures from the Assault Base: Departure procedures are identical to those in Plans I-B, II, and II-B, with the exception of a change in the departure track of aircraft departing to the southwest (FIG. V-1). Departures are released by the assault base controller in accordance with the Departure Control Chart-Assault Base (FIG. V-3). Departures on the northwesterly departure track climb to altitudes below those in use by aircraft enroute to the assault base, while departures on the southwesterly departure track climb to altitudes above those in use by aircraft enroute to the assault base. The visual flight condition restriction is still included in the clearance to aircraft departing on the northwesterly track even though they are below enroute aircraft on the track from "JH" to "MA". This is necessary to maintain lateral separation between these departures and the enroute aircraft on the direct track from the "DB" NDB to the "MA" NDB which are at the same altitudes.

Penetration Procedures at the Fixed Base: Penetration procedures at the fixed base differ from other plans (FIG. V-1). Aircraft returning via the northern route to the "JH" NDB, are at the lower altitudes. Since there are only two penetration legs and three altitudes in use, one of the legs has multiple penetrations. In the case of an emergency return, both penetration legs have three penetrations. In addition, instead of the desired 1200 foot vertical separation between aircraft penetrating on any particular leg, there is only 800 feet. To compensate for this, the first or lower aircraft in each leg maintain assigned altitude for 30 seconds prior to descending, the next higher aircraft is given an additional 30 seconds, or a 1-minute time restriction to maintain altitude prior to penetrating. This additional 30 seconds provides the desired 1.5 NM longitudinal separation between aircraft at the time they become visual. Each aircraft at succeeding altitudes in the penetration legs receives an additional 30 seconds time restriction.

The penetrations at the "DB" NDB, are from the higher altitudes returning from the assault base. The same procedures are used at the "DB" NDB at the "JH" NDB; however, to protect airspace in the event of an emergency return, these aircraft are given additional time restrictions for penetration (FIG. V-1).

Aircraft which use the inside penetration tracks, 261° track off "DB" and 267° track off "JH", upon reaching visual flight conditions make right and left turns respectfully and proceed direct to the fixed base. Aircraft penetrating on the outer tracks; 216° track off "DB" and 312° track off "JH", make a left and right turn respectfully (FIG. V-1) after reaching visual conditions, to intercept an assigned track to the NDB's and from over the NDB, proceed at low altitude direct to the fixed base. These procedures are outlined for the pilots in their "R" clearances.

Emergency Return Procedures:

The emergency return and penetration procedure to both radio beacons is shown in Figure V-4.

Controller Duties During Emergency Return Procedure:

Assault Base Controller - This controller performs the duties as outlined in Plan II.

Fixed Base Controller - This controller performs the duties as outlined in Plan II.

Missed Approaches - Missed approach instructions indicate to the pilots that upon reaching their assigned missed approach altitudes, to make a left turn and proceed direct to the "JH" NDB. Holding instructions are included in their missed approach procedures for each "D" clearance from fixed base. Holding is accomplished at altitudes from 2800 feet AGL to 4800 feet AGL at "JH" on a track of 267° inbound, 1 minute right turns. Pilots must contact the assault base controller immediately on initiating the missed approach, and must also contact the fixed base controller approaching the "JH" NDB for penetration clearance and instructions.

The missed approach altitudes (FIG. III-5) are above those altitudes used by enroute aircraft to the assault base and those enroute back to the fixed base. Second Approaches are not practical at the assault base.

Controller Duties During Missed Approaches:

Assault Base Controller - Since the assigned missed approach altitudes are above those used for the normal flow of traffic, the assault base controller need only copy the aircraft identification and altitude to which the missed approach has climbed and coordinate this information with the fixed base controller.

Fixed Base Controller - Upon notification from the assault base controller of a missed approach or multiple missed approaches, the fixed base controller will be prepared to issue clearances to these aircraft upon radio contact with them as they approach the "JH" NDB. The

controller can determine a penetration leg and time restriction off the "JH" NDB for a letdown.

Clearances: The following clearances are used in this plan:

A. Departure from Fixed Base:

D-30 Track 081° from the DB Rbn, climb to and maintain 400 feet. Track 036° from the MA Rbn, maintain 400 feet for 30 seconds, then descend to visual flight conditions (200 feet). Upon reaching visual flight conditions, turn right to intercept a track of 226° to the Assault Base Rbn.

Missed Approach Procedure -

Turn left to heading 351°, maintain 200 feet for 30 seconds, then climb to and maintain 2800 feet. Upon reaching 2800 feet, turn left, proceed direct to the JH Rbn. Hold east of JH on 267° track, 1 minute, right turns. Contact DB Controller for approach instructions.

D-31 Track 081° from the DB Rbn, climb to and maintain 800 feet. Track 081° from the MA Rbn, maintain 800 feet for 30 seconds, then descend to visual flight conditions (200 feet). Upon reaching visual flight conditions turn right, to intercept a track of 271° to the Assault Base Rbn.

Missed Approach Procedure -

Turn left to heading of 036°, maintain 200 feet for 30 seconds, then climb to and maintain 3600 feet. Upon reaching 3600 feet, turn left, proceed direct to the JH Rbn. Hold East of JH on 267° track, 1 minute, right turns, contact the DB Controller for approach instructions.

D-32 Track 081° from the DB Rbn, climb to and maintain 1200 feet. Track 126° from the MA Rbn, maintain 1200 feet for 30 seconds then descend to visual flight conditions (200 feet). Upon reaching visual flight conditions, turn right to intercept a track of 316° to the Assault Base Rbn.

Missed Approach Procedure -

Turn left to heading 081°, maintain 200 feet for 30 seconds then climb to and maintain 4400 feet. Upon reaching 4400 feet, turn left, proceed direct to the JH Rbn. Hold East of JH on 267° track 1 minute, right turns, contact the DB Controller for approach instructions.

D-33 Track 087° from the JH Rbn, climb to and maintain 1600 feet. Track 036° from the MA Rbn, maintain 1600 feet for 30 seconds then descend to visual flight conditions (200 feet). Upon reaching visual flight conditions turn right, to intercept a track of 226° to the Assault Base Rbn.

Missed Approach Procedure -

Turn left to heading 351°, maintain 200 feet for 30 seconds then climb to and maintain 3200 feet. Upon reaching 3200 feet turn left, proceed direct to the JH Rbn. Hold East of JH on 267° track 1 minute, right turns, contact the DB Controller for approach instructions.

D-34 Track 087° from the JH Rbn, climb to and maintain 2000 feet. Track 081° from the MA Rbn, maintain 2000 feet for 30 seconds then descend to visual flight conditions (200 feet). Upon reaching visual flight conditions turn right to intercept a track of 271° to the Assault Base Rbn.

Missed Approach Procedure -

Turn left to heading 036°, maintain 200 feet for 30 seconds, then climb to and maintain 4000 feet. Upon reaching 4000 feet, turn left, proceed direct to the JH Rbn. Hold East of the JH Rbn on track of 267° 1 minute right turns, contact the DB Controller for approach instructions.

D-35 Track 087° from the JH Rbn, climb to and maintain 2400 feet. Track 126° from the MA Rbn, maintain 2400 feet for 30 seconds then descend to visual flight conditions (200 feet). Upon reaching visual flight conditions turn right, to intercept a track of 316° to the Assault Base Rbn.

Missed Approach Procedure -

Turn left to a heading of 081°, maintain 200 feet for 30 seconds then climb to and maintain 4800 feet. Upon reaching 4800 feet, turn left, proceed direct to the JH Rbn. Hold East of the JH Rbn on track of 267° 1 minute right turns, contact the DB Controller for approach instructions.

B. Departure from Assault Base:

R-30 Track 306° from the MA Rbn, maintain visual flight conditions at or below 200 feet for 3 min. 45 sec., then climb to and maintain 400 feet. Maintain track of 306° until intercepting a track of 247° to the JH Rbn. Track 267° from the JH Rbn, maintain 400 feet for 30 seconds then descend to visual flight conditions (200 feet). Upon reaching visual flight conditions turn left, proceed direct to the Fixed Base.

R-31 Track 306° from the MA Rbn, maintain visual flight conditions at or below 200 feet for 3 min. 45 sec., then climb to and maintain 800 feet. Maintain track of 306° until intercepting a track of 247° to the JH Rbn. Track 312° from the JH Rbn, maintain 800 feet for 30 seconds then descend to visual flight conditions (200 feet). Upon reaching visual flight conditions turn right, to intercept a track of 142° to the JH Rbn, then from over the JH Rbn, proceed direct to the Fixed Base.

R-32 Track 306° from the MA Rbn, maintain visual flight at or below 200 feet 3 min. 45 seconds, then climb to and maintain 1200 feet. Maintain track of 306° until intercepting a track of 247° to the JH Rbn. Track 267° from the JH Rbn, maintain 1200 feet for 1 minute then descend to visual flight conditions (200 feet). Upon reaching visual flight conditions turn left proceed direct to the Fixed Base.

R-33 Track 216° from the MA Rbn, maintain visual flight at or below 200 feet for 3 minutes 45 seconds, then climb to and maintain 1600 feet. Maintain track of 216° until intercepting a track of 281° to the DB Rbn. Track 261° from the DB Rbn, maintain 1600 feet for 1 minute then descend to visual flight conditions (200 feet). Upon reaching visual flight conditions turn right and proceed direct to the Fixed Base.

R-34 Track 216° from the MA Rbn, maintain visual flight at or below 200 feet for 3 minutes 45 seconds then climb to and maintain 2000 feet. Maintain track of 216° until intercepting a track of 281° to the DB Rbn. Track 216° from the DB Rbn, maintain 2000 feet for 1 minute 30 seconds, then descend to visual flight conditions (200 feet). Upon reaching visual flight conditions turn left, to intercept a track of 026° to the DB Rbn, then from over the DB Rbn, proceed direct to the Fixed Base.

R-35 Track 216° from the MA Rbn, maintain visual flight at or below 200 feet for 3 minutes 45 seconds, then climb to and maintain 2400 feet. Maintain track of 216° until intercepting a track of 281° to the DB Rbn. Track 261° from the DB Rbn, maintain 2400 feet for 1 minute 30 seconds then descend to visual flight conditions (200 feet). Upon reaching visual flight conditions turn right, proceed direct to the Fixed Base.

C. Emergency Return Procedure:

Aircraft Enroute Between the DB and MA Beacons -

When advised by either the Fixed Base or Assault Base Controller to execute Emergency Return Procedure:

All aircraft will immediately turn right to a heading of 181°, maintain assigned altitude. Maintain heading 181° until intercepting a track of 271° to the DB Rbn.

Aircraft Enroute Between the JH and MA Beacons

When advised by either the Fixed Base or Assault Base Controller to execute Emergency Return Procedure:

All aircraft will immediately turn left to a heading of 347°, maintain assigned altitude. Maintain heading 347° until intercepting a track of 257° to the JH Rbn.

See Figure V-4 for illustration of the penetration procedures at each radio beacon when making an emergency return to fixed base.

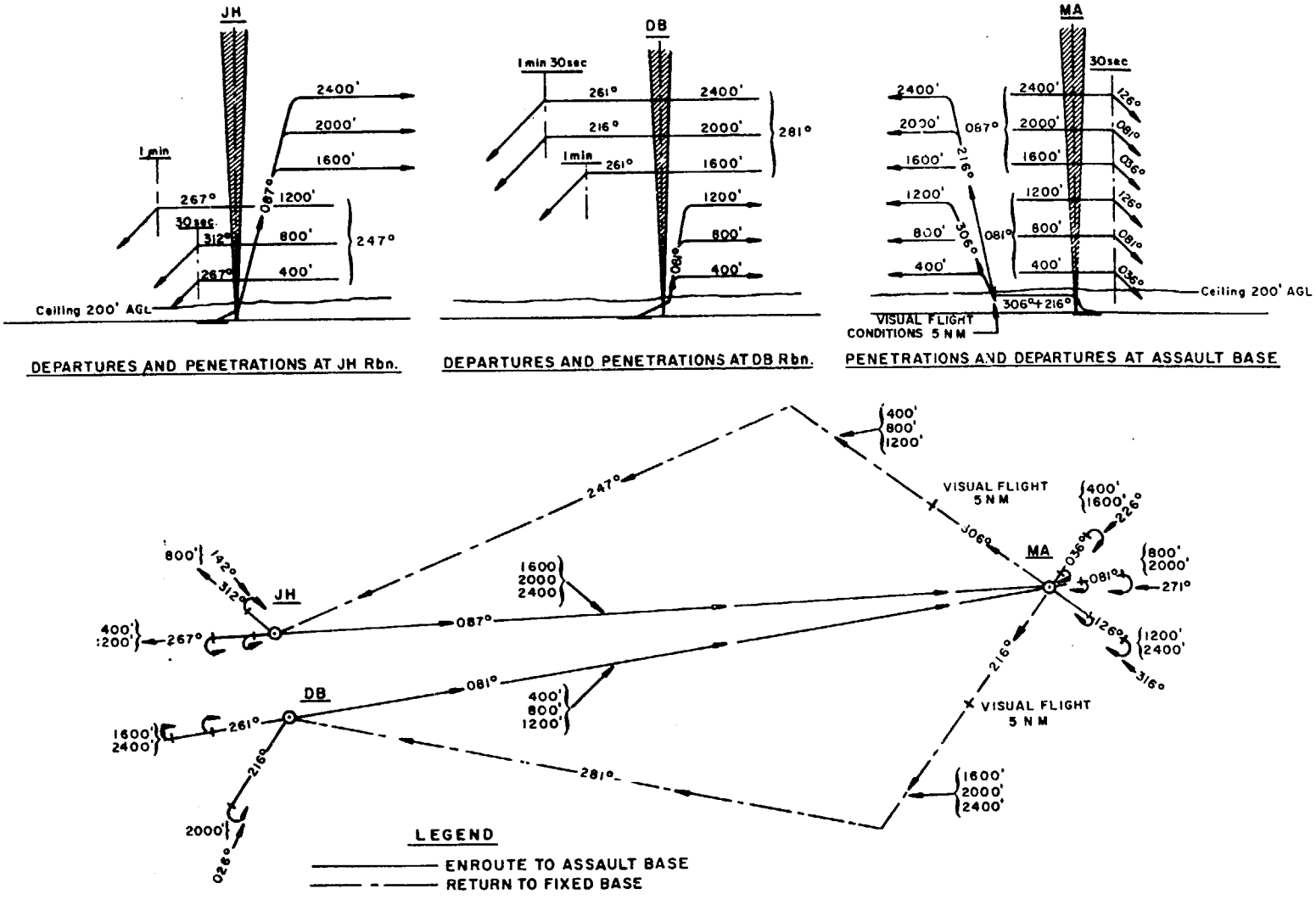


FIG. V-1 DEPARTURE, PENETRATION PROCEDURES, AND TRAFFIC FLOW DIAGRAM - PLAN III

DEPARTURE CONTROL CHART FIXED BASE

SCHEDULED DEPARTURE TIME	ACFT. IDENT.	TYPE ACFT.	CLEARANCE ALTITUDE	SCHEDULED DEPARTURE TIME	ACFT. IDENT.	TYPE ACFT.	CLEARANCE ALTITUDE
:00		UH - 1	D-30/400'	:30		UH - 1	D-30/400'
:00		UH - 1	D-33/1600'	:30		UH - 1	D-33/1600'
:01		UH - 1	D-31/800'	:31		UH - 1	D-31/800'
:01		UH - 1	D-34/2000'	:31		UH - 1	D-34/2000'
:02		UH - 1	D-32/1200'	:32		UH - 1	D-32/1200'
:02		UH - 1	D-35/2400'	:32		UH - 1	D-35/2400'
:03				:33			
:03				:33			
:04				:34			
:04				:34			
:05		UH - 1	D-30/400'	:35		UH - 1	D-30/400'
:05		UH - 1	D-33/1600'	:35		UH - 1	D-33/1600'
:06		UH - 1	D-31/800'	:36		UH - 1	D-31/800'
:06		UH - 1	D-34/2000'	:36		UH - 1	D-34/2000'
:07		UH - 1	D-32/1200'	:37		UH - 1	D-32/1200'
:07		UH - 1	D-35/2400'	:37		UH - 1	D-35/2400'
:08				:38			
:08				:38			
:09				:39			
:09				:39			
:10		UH - 1	D-30/400'	:40		UH - 1	D-30/400'
:10		UH - 1	D-33/1600'	:40		UH - 1	D-33/1600'
:11		UH - 1	D-31/800'	:41		UH - 1	D-31/800'
:11		UH - 1	D-34/2000'	:41		UH - 1	D-34/2000'
:12		UH - 1	D-32/1200'	:42		UH - 1	D-32/1200'
:12		UH - 1	D-35/2400'	:42		UH - 1	D-35/2400'
:13				:43			
:13				:43			
:14				:44			
:14				:44			
:15		UH - 1	D-30/400'	:45		UH - 1	D-30/400'
:15		UH - 1	D-33/1600'	:45		UH - 1	D-33/1600'
:16		UH - 1	D-31/800'	:46		UH - 1	D-31/800'
:16		UH - 1	D-34/2000'	:46		UH - 1	D-34/2000'
:17		UH - 1	D-32/1200'	:47		UH - 1	D-32/1200'
:17		UH - 1	D-35/2400'	:47		UH - 1	D-35/2400'
:18				:48			
:18				:48			
:19				:49			
:19				:49			
:20		UH - 1	D-30/400'	:50		UH - 1	D-30/400'
:20		UH - 1	D-33/1600'	:50		UH - 1	D-33/1600'
:21		UH - 1	D-31/800'	:51		UH - 1	D-31/800'
:21		UH - 1	D-34/2000'	:51		UH - 1	D-34/2000'
:22		UH - 1	D-32/1200'	:52		UH - 1	D-32/1200'
:22		UH - 1	D-35/2400'	:52		UH - 1	D-35/2400'
:23				:53			
:23				:53			
:24				:54			
:24				:54			
:25		UH - 1	D-30/400'	:55		UH - 1	D-30/400'
:25		UH - 1	D-33/1600'	:55		UH - 1	D-33/1600'
:26		UH - 1	D-31/800'	:56		UH - 1	D-31/800'
:26		UH - 1	D-34/2000'	:56		UH - 1	D-34/2000'
:27		UH - 1	D-32/1200'	:57		UH - 1	D-32/1200'
:27		UH - 1	D-35/2400'	:57		UH - 1	D-35/2400'
:28				:58			
:28				:58			
:29				:59			
:29				:59			

FIG. V-2 DEPARTURE CONTROL CHART - FIXED BASE - PLAN III

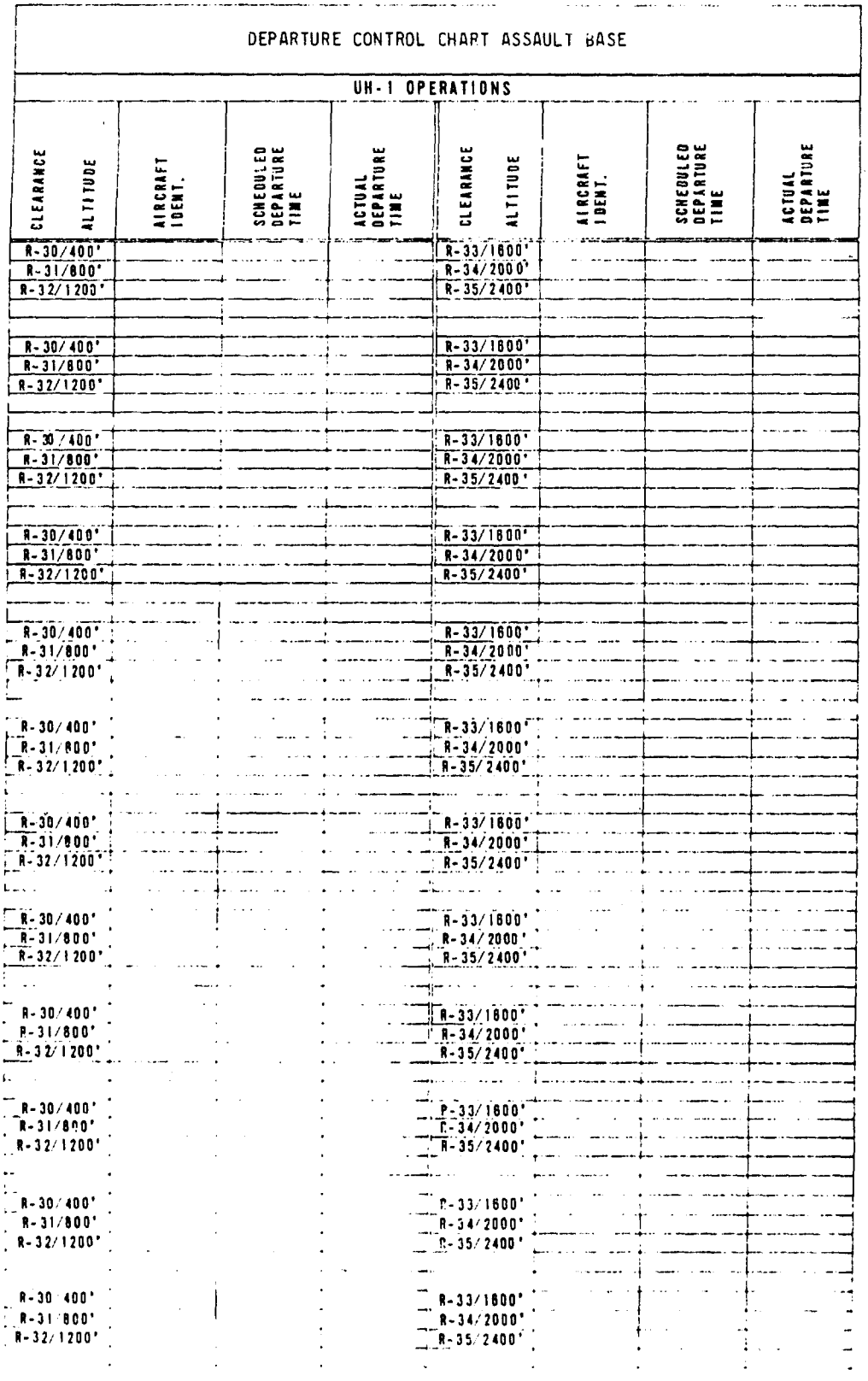
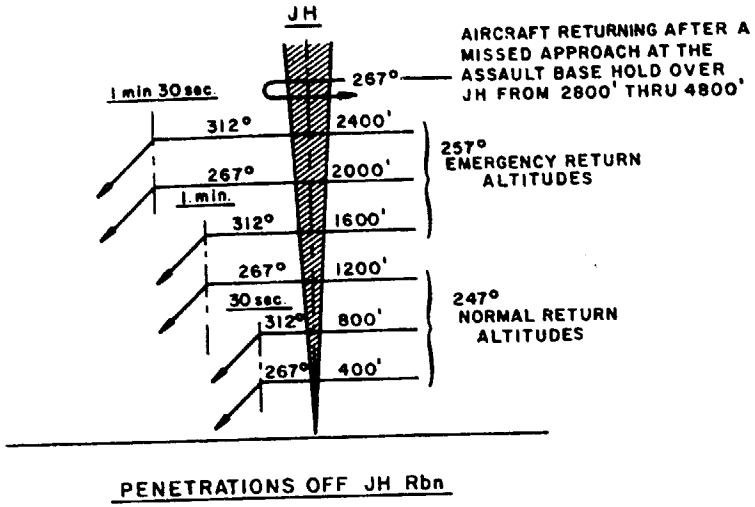
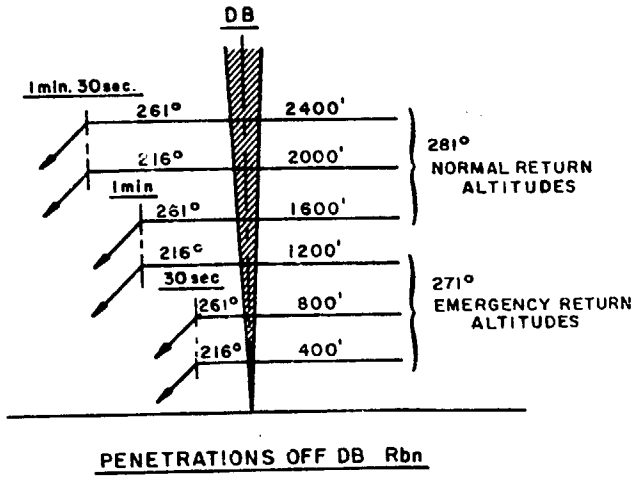


FIG. V-3 DEPARTURE CONTROL CHART - ASSAULT BASE - PLAN III



PENETRATIONS OFF JH Rbn



PENETRATIONS OFF DB Rbn

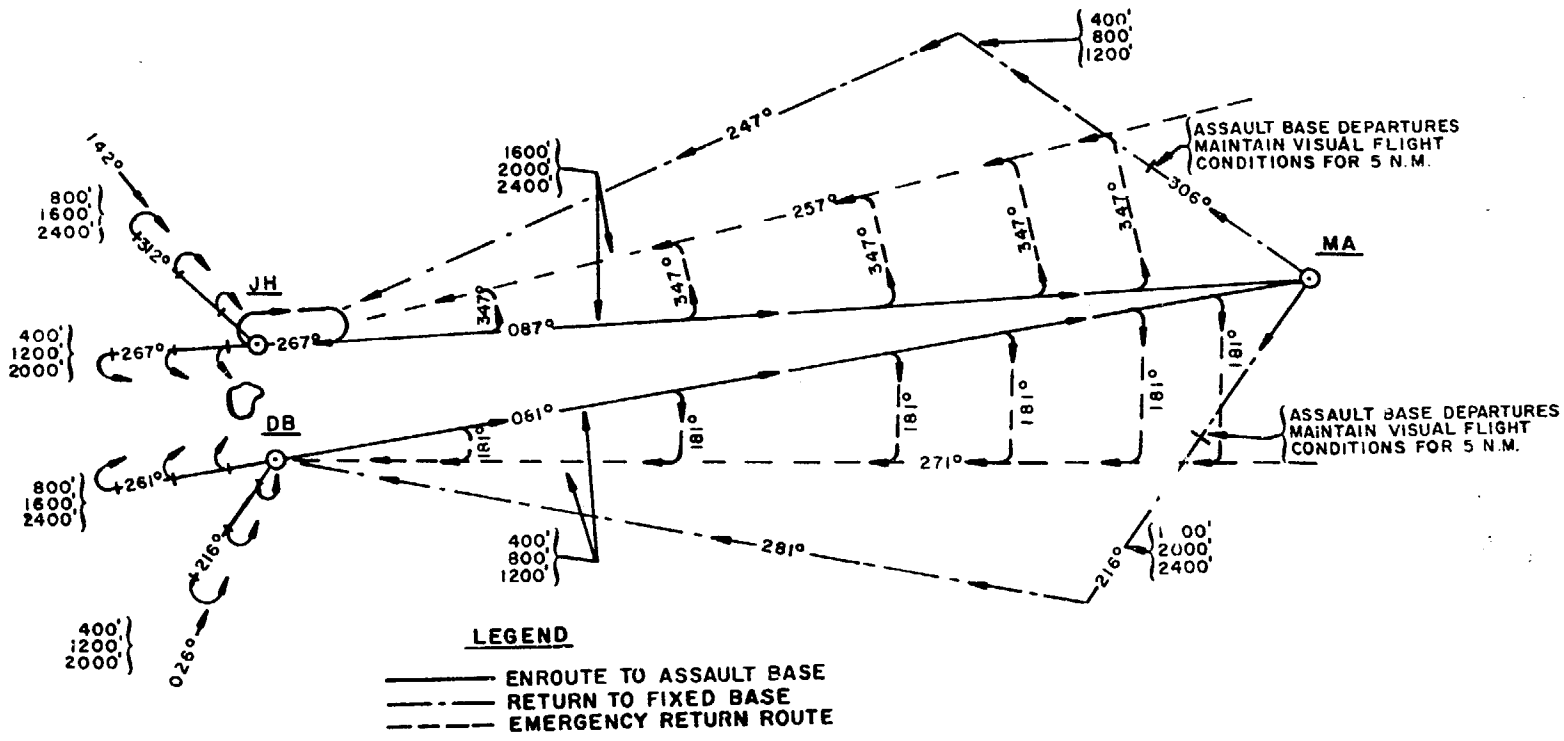


FIG. V-4 EMERGENCY RETURN AND PENETRATION PROCEDURE - PLAN III

APPENDIX VI

PLAN IV

General: This is a modification to the planning for use of two nondirectional radio beacons at the fixed base. This plan uses six altitudes and a preferential route, or one-way system, in which departures track off the "DB" NDB from the fixed base to the assault base and return from the assault base via an off-course route to the "JH" NDB.

Unlike Plan III, there is no inherent restriction between departures and arrivals at the fixed base. Therefore, there is no reduction in the capability of this plan in a continuous operation. This plan which includes both CH-47 and UH-1 Helicopters has a theoretical arrival rate of 78 aircraft per hour at the assault base.

As in Plan III, the aircraft enroute from the fixed base to the assault base, and those returning to the fixed base, utilize the same altitudes which keeps the top altitude in use at 2400 feet AGL. In this plan there is no interaction between aircraft making an emergency return to fixed base and departures off the assault base.

Departures from Fixed Base: The routes and altitudes assigned to the CH-47 and UH-1 Helicopters are shown in Figure VI-1. Controllers release departures with respect to the Departure Control Chart-Fixed Base (FIG. VI-2).

Penetration Procedure at Assault Base: Due to emergency return procedure requirements it is not possible to isolate the CH-47 Helicopters to a single penetration leg (FIG. VI-1). In view of this, the CH-47's are assigned the higher altitudes over different penetration legs. Since the CH-47's climb and descent profile is different and the distance traveled from the NDB's in their penetration from these altitudes is a slight distance shorter than the UH-1's, an additional 15-second time restriction is added prior to beginning penetration after passing the "MA" NDB.

Departures from Assault Base: Departures are released in accordance with the Departure Control Chart-Assault Base (FIG. VI-3). The departure procedure differs in some respects from the previous plans as the departure tracks are both northwesterly (FIG. VI-1). The CH-47 Helicopters, due to their greater angle of divergence from the inbound route, need only a 3-mile visual flight restriction, which is converted to time, to clear the arrival route.

Penetration at the Fixed Base: In this plan, penetrations are made off the "JH" radio beacon (FIG. VI-1). As in Plan III, there is only 800 feet vertical separation between aircraft penetrating in a penetration leg. To compensate, additional time restrictions are added to the higher altitudes in each penetration leg. The CH-47 type helicopters on the return route are given the two higher enroute altitudes. This procedure places the CH-47's on the top penetration altitude on each penetration leg. Because of the slightly less distance traveled in their penetrations, an additional time restriction is used.

Emergency Return Procedure: To keep the flight distance required in the emergency return procedures to a minimum, a slightly different procedure is designed for this Plan (FIG. VI-4). The procedure for the CH-47's is identical to Plan I-B and II-B. These aircraft make a right or left turn to a specified heading to intercept a return track to the "DB" radio beacon.

The UH-1 helicopters who are still on the original departure track of 091°, make a standard rate turn to the right to intercept a return track of 271° back to the "DB" radio beacon. The UH-1's that have already made their turn toward the assault base, are required to make a right turn to a magnetic heading of 181 degrees until intercepting the 271° track. In this plan, the emergency return procedures has no interaction with the normal flow of aircraft returning from the assault base. Penetration procedures at the "DB" radio beacon are outlined for the pilot in his emergency return procedure.

Controller Duties During the Emergency Return Procedure:

Assault Base Controller:

1. Coordinate with the fixed base controller, advise that the emergency return procedure is about to be initiated.

2. Broadcast to all aircraft enroute from fixed base to assault base to execute the emergency return procedure.

Fixed Base Controller:

1. Stop all departures from the fixed base.

2. Ascertain that all departures have reached their assigned altitudes.

3. Advise the assault base controller that the emergency return procedure may be initiated.

4. Broadcast to all aircraft enroute from fixed base to assault base to execute the emergency return procedure. (This must be accomplished by the fixed base controller prior to or simultaneously with the assault base controller).

Missed Approaches: All missed approaches (FIG. III-5) are instructed upon reaching their assigned altitudes to proceed direct to the "JH" radio beacon. Holding instructions are included in the missed approach procedures. Second approaches to the assault base are not practical.

Controller Duties During Missed Approaches:

Assault Base Controller:

Same as in Plan III.

Fixed Base Controller:

Same as in Plan III.

Clearances: The following clearances are used in this plan:

A. Departure from Fixed Base:

D-40 Track 091° from the DB Rbn, climb to and maintain 400 feet. Track 091° until intercepting a track of 061° to the MA Rbn. Track 036° from the MA Rbn, maintain 400 feet for 30 seconds, then descend to visual flight conditions (200 feet). Upon reaching visual flight conditions, turn right to intercept a track of 226° to the Assault Base Rbn.

Missed Approach Procedure -

Turn left heading 351°, maintain 200 feet for 30 seconds, then climb to 2800 feet. Upon reaching 2800 feet, turn left, proceed direct to the JH Rbn. Hold East of JH on 267° track, 1 minute, right turns. Contact DB controller for approach instructions.

D-41 Track 091° from the DB Rbn, climb to and maintain 800 feet. Track 091° until intercepting a track of 061° to the MA Rbn. Track 081° from the MA Rbn, maintain 800 feet for 30 seconds, then descend to visual flight conditions (200 feet). Upon reaching visual flight conditions turn right to intercept a track of 271° to the Assault Base Rbn.

Missed Approach Procedure -

Turn left heading 036°, maintain 200 feet for 30 seconds, then climb to and maintain 3600 feet. Upon reaching 3600 feet, turn left, proceed direct to the JH Rbn. Hold East of JH on 267° track 1 minute, right turns. Contact DB controller for approach instructions.

D-42 Track 091° from the DB Rbn, climb to and maintain 1200 feet. Track 091° until intercepting a track of 061° to the MA Rbn. Track 126° from the MA Rbn, maintain 1200 feet for 30 seconds, then descend to visual flight conditions (200 feet). Upon reaching visual flight conditions, turn right to intercept a track of 316° to the Assault Base Rbn.

Missed Approach Procedure -

Turn left heading 081°, maintain 200 feet for 30 seconds, then climb to and maintain 4400 feet. Upon reaching 4400 feet, make left turn, proceed direct to the JH Rbn. Hold East of JH on 267° track, 1 minute, right turns. Contact DB Controller for approach instructions.

D-43 Track 091° from the DB Rbn, climb to and maintain 1600 feet. Track 091° until intercepting a track of 061° to the MA Rbn. Track 036° from the MA Rbn, maintain 1600 feet for 30 seconds then descend to visual flight conditions (200 feet). Upon reaching visual flight conditions turn right to intercept a track of 226° to the Assault Base Rbn.

Missed Approach Procedure -

Turn left heading 351°, maintain 200 feet for 30 seconds, then climb to and maintain 3200 feet. Upon reaching 3200 feet, turn left, proceed direct to the JH Rbn. Hold East of JH on 267° track, 1 minute, right turns. Contact DB controller for approach instructions.

D-44 Track 121° from the DB Rbn, climb to and maintain 2000 feet. Track 121° until intercepting a track of 073° to the MA Rbn. Track 081° from the MA Rbn, maintain 2000 feet for 45 seconds, then descend to visual flight conditions (200 feet). Upon reaching visual flight conditions, turn right to intercept a track of 271° to the Assault Base Rbn.

Missed Approach Procedure -

Turn left heading 036° maintain 200 feet for 30 seconds then climb to and maintain 4000 feet. Upon reaching 4000 feet, turn left, proceed direct to the JH Rbn. Hold East of JH on 267° track 1 minute, right turns. Contact DB controller for approach instructions.

D-45 Track 121° from the DB Rbn, climb to and maintain 2400 feet. Track 121° until intercepting a track of 073° to the MA Rbn. Track 126° from the MA Rbn, maintain 2400 feet for 45 seconds. Then descend to visual

flight conditions (200 feet). Upon reaching visual flight conditions, turn right to intercept a track of 316° to the Assault Base Rbn.

Missed Approach Procedure -

Turn left heading 081°, maintain 200 feet for 30 seconds, then climb to 4800 feet. Upon reaching 4800 turn left, proceed direct to the JH Rbn. Hold East of JH on 267° track 1 minute, right turns. Contact DB controller for approach instructions.

B. Departure from Assault Base:

R-40 Track 286° from the MA Rbn, maintain visual flight at or below 200 feet for 3 min. 45 sec., then climb to and maintain 400 feet. Track 286° until intercepting a track of 252° to the JH Rbn. Track 267° from the JH Rbn, maintain 400 feet for 30 seconds, then descend to visual flight conditions (200 feet). Upon reaching visual flight conditions, turn left, proceed direct to the Fixed Base.

R-41 Track 286° from the MA Rbn, maintain visual flight at or below 200 feet for 3 min. 45 sec. then climb to and maintain 800 feet. Track 286° until intercepting a track of 252° to the JH Rbn. Track 312° from the JH Rbn, maintain 800 feet for 30 seconds then descend to visual flight conditions (200 feet). Upon reaching visual flight conditions, turn right to intercept a track of 142° to the JH Rbn, then from over the Rbn proceed direct to the Fixed Base.

R-42 Track 286° from the MA Rbn, maintain visual flight at or below 200 feet for 3 min. 45 sec., then climb to and maintain 1200 feet. Track 286° until intercepting a track of 252° to the JH Rbn. Track 267° from the JH Rbn, maintain 1200 feet for 1 minute then descend to visual flight conditions (200 feet). Upon reaching visual flight conditions turn left, proceed direct to the Fixed Base.

R-43 Track 286° from the MA Rbn, maintain visual flight at or below 200 feet for 3 min. 45 sec. then climb to and maintain 1600 feet. Track 286° until intercepting a track of 252° to the JH Rbn. Track 312° from the JH

Rbn. Maintain 1600 feet for 1 minute then descend to visual flight conditions (200 feet). Upon reaching visual flight conditions, turn right to intercept a track of 142° to the JH Rbn, then from over the JH Rbn proceed direct to the Fixed Base.

R-44 Track 316° from the MA Rbn, maintain visual flight at or below 200 feet for 1 minute 45 seconds then climb to and maintain 2000 feet. Track 316° until intercepting a track of 252° to the JH Rbn. Track 267° from the JH Rbn, maintain 2000 feet for 1 minute 45 seconds then descend to visual flight conditions (200 feet). Upon reaching visual flight conditions, turn left, proceed direct to the Fixed Base.

R-45 Track 316° from the MA Rbn, maintain visual flight at or below 200 feet for 1 minute 45 seconds then climb to and maintain 2400 feet. Track 316° until intercepting a track of 252° to the JH Rbn. Track 312° from the JH Rbn, maintain 2400 feet for 1 minute 45 seconds then descend to visual flight conditions (200 feet). Upon reaching visual flight conditions turn right to intercept a track of 142° to the JH Rbn, then from over JH Rbn, proceed direct to the Fixed Base.

C. Emergency Return Procedure:

Acft. on 091° track from DB

Make standard rate turn to the right to intercept 271° track to the DB Rbn.

Acft. South of 271° track to DB

Turn left heading 001° to intercept.

Acft. North of 271° track to DB

Turn right heading 181°, to intercept.

See Figure VI-4 for illustration of the penetration procedures when making an emergency return to fixed base.

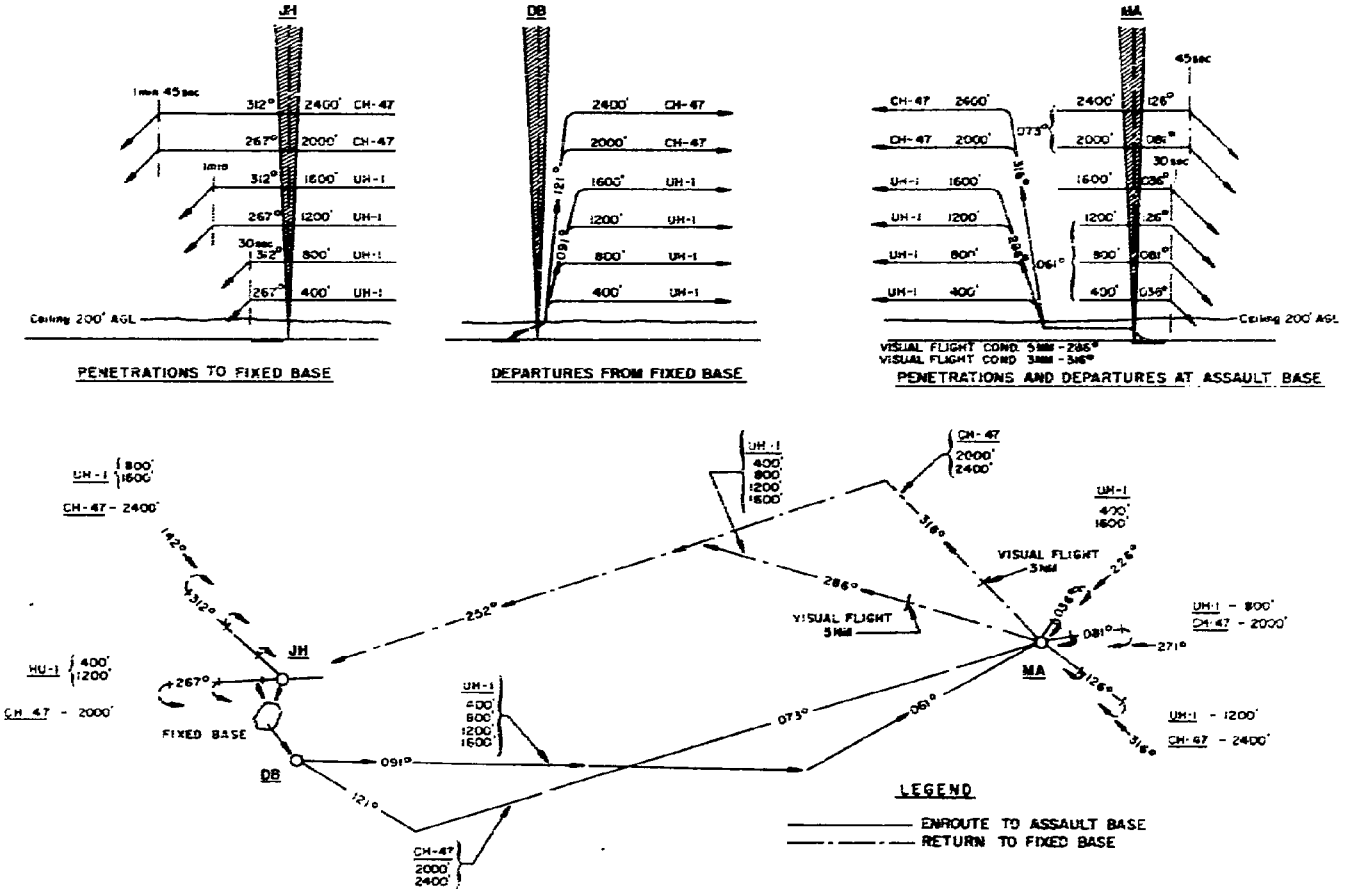


FIG. VI-1 DEPARTURE, PENETRATION PROCEDURES, AND TRAFFIC FLOW DIAGRAM - PLAN IV

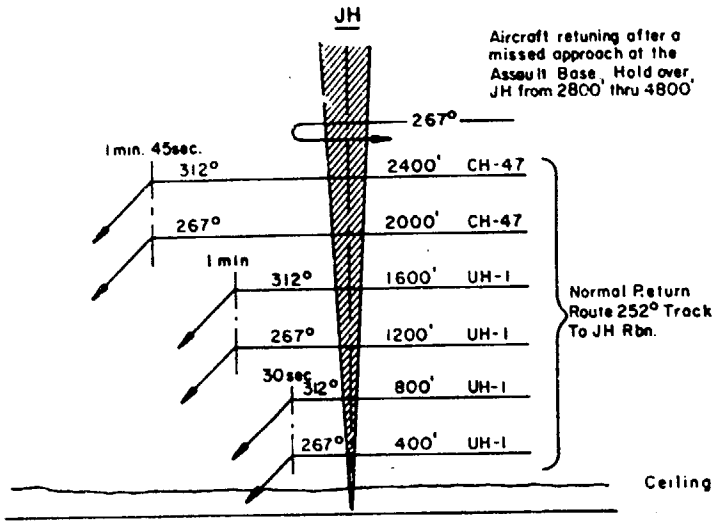
DEPARTURE CONTROL CHART FIXED BASE

SCHEDULED DEPARTURE TIME	ACFT. IDENT.	TYPE ACFT.	CLEARANCE ALTITUDE	SCHEDULED DEPARTURE TIME	ACFT. IDENT.	TYPE ACFT.	CLEARANCE ALTITUDE
:00		UH - 1	D-40/400'	:30		UH - 1	D-40/400'
:00		CH - 47	D-44/2000'	:30			
:01		UH - 1	D-41/800'	:31		UH - 1	D-41/800'
:01		CH - 47	D-45/2400'	:31			
:02		UH - 1	D-42/1200'	:32		UH - 1	D-42/1200'
:02				:32		CH - 47	D-44/2000'
:03		UH - 1	D-43/1800'	:33		UH - 1	D-43/1800'
:03				:33		CH - 47	D-45/2400'
:04		CH - 47	D-44/2000'	:34			
:04				:34			
:05		UH - 1	D-40/400'	:35		UH - 1	D-40/400'
:05		CH - 47	D-45/2400'	:35			
:06		UH - 1	D-41/800'	:36		UH - 1	D-41/800'
:08				:36		CH - 47	D-44/2000'
:07		UH - 1	D-42/1200'	:37		UH - 1	D-42/1200'
:07				:37		CH - 47	D-45/2400'
:08		UH - 1	D-43/1800'	:38		UH - 1	D-43/1800'
:08		CH - 47	D-44/2000'	:38			
:09		CH - 47	D-45/2400'	:39			
:09				:39			
:10		UH - 1	D-40/400'	:40		UH - 1	D-40/400'
:10				:40		CH - 47	D-44/2000'
:11		UH - 1	D-41/800'	:41		UH - 1	D-41/800'
:11				:41		CH - 47	D-45/2400'
:12		UH - 1	D-42/1200'	:42		UH - 1	D-42/1200'
:12		CH - 47	D-44/2000'	:42			
:13		UH - 1	D-43/1800'	:43		UH - 1	D-43/1800'
:13		CH - 47	D-45/2400'	:43			
:14				:44		CH - 47	D-44/2000'
:14				:44			
:15		UH - 1	D-40/400'	:45		UH - 1	D-40/400'
:15				:45		CH - 47	D-45/2400'
:16		UH - 1	D-41/800'	:46		UH - 1	D-41/800'
:16		CH - 47	D-44/2000'	:46			
:17		UH - 1	D-42/1200'	:47		UH - 1	D-42/1200'
:17		CH - 47	D-45/2400'	:47			
:18		UH - 1	D-43/1800'	:48		UH - 1	D-43/1800'
:18				:48		CH - 47	D-44/2000'
:19				:49		CH - 47	D-45/2400'
:19				:49			
:20		UH - 1	D-40/400'	:50		UH - 1	D-40/400'
:20		CH - 47	D-44/2000'	:50			
:21		UH - 1	D-41/800'	:51		UH - 1	D-41/800'
:21		CH - 47	D-45/2400'	:51			
:22		UH - 1	D-42/1200'	:52		UH - 1	D-42/1200'
:22				:52		CH - 47	D-44/2000'
:23		UH - 1	D-43/1800'	:53		UH - 1	D-43/1800'
:23				:53		CH - 47	D-45/2400'
:24		CH - 47	D-44/2000'	:54			
:24				:54			
:25		UH - 1	D-40/400'	:55		UH - 1	D-40/400'
:25		CH - 47	D-45/2400'	:55			
:26		UH - 1	D-41/800'	:56		UH - 1	D-41/800'
:26				:56		CH - 47	D-44/2000'
:27		UH - 1	D-42/1200'	:57		UH - 1	D-42/1200'
:27				:57		CH - 47	D-45/2400'
:28		UH - 1	D-43/1800'	:58		UH - 1	D-43/1800'
:28		CH - 47	D-44/2000'	:58			
:29		CH - 47	D-45/2400'	:59			
:29				:59			

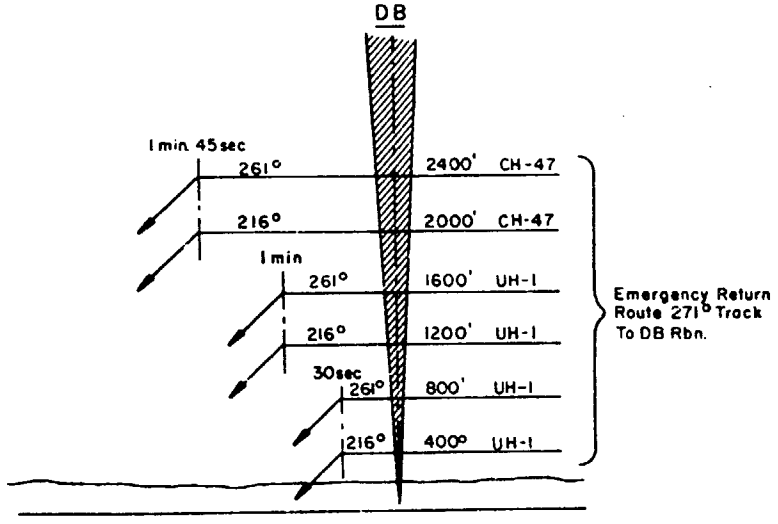
FIG. VI-2 DEPARTURE CONTROL CHART - FIXED BASE - PLAN IV

DEPARTURE CONTROL CHART ASSAULT BASE							
UH-1 OPERATIONS				CH-47 OPERATIONS			
CLEARANCE ALTITUDE	AIRCRAFT IDENT.	SCHEDULED DEPARTURE TIME	ACTUAL DEPARTURE TIME	CLEARANCE ALTITUDE	AIRCRAFT IDENT	SCHEDULED DEPARTURE TIME	ACTUAL DEPARTURE TIME
R-40/400'				R-44/2000'			
R-41/800'				R-45/2400'			
R-42/1200'							
R-43/1600'							
				R-44/2000'			
R-40/400'				R-45/2400'			
R-41/800'							
R-42/1200'							
R-43/1600'				R-44/2000'			
				R-45/2400'			
R-40/400'							
R-41/800'							
R-42/1200'				R-44/2000'			
R-43/1600'				R-45/2400'			
R-40/400'							
R-41/800'				R-44/2000'			
R-42/1200'				R-45/2400'			
R-43/1600'							
R-40/400'				R-44/2000'			
R-41/800'				R-45/2400'			
R-42/1200'							
R-43/1600'							
				R-44/2000'			
R-40/400'				R-45/2400'			
R-41/800'							
R-42/1200'							
R-43/1600'				R-44/2000'			
				R-45/2400'			
R-40/400'							
R-41/800'							
R-42/1200'				R-44/2000'			
R-43/1600'				R-45/2400'			
R-40/400'							
R-41/800'				R-44/2000'			
R-42/1200'				R-45/2400'			
R-43/1600'							
				R-44/2000'			
R-40/400'				R-45/2400'			
R-41/800'							
R-42/1200'							
R-43/1600'				R-44/2000'			
				R-45/2400'			
R-40/400'							
R-41/800'							
R-42/1200'				R-44/2000'			
R-43/1600'				R-45/2400'			
R-40/400'							
R-41/800'				R-44/2000'			
R-42/1200'				R-45/2400'			
R-43/1600'							

FIG. VI-3 DEPARTURE CONTROL CHART - ASSAULT BASE - PLAN IV



NORMAL PENETRATION OFF JH RBN.



EMERGENCY RETURN PENETRATION OFF JH RBN.

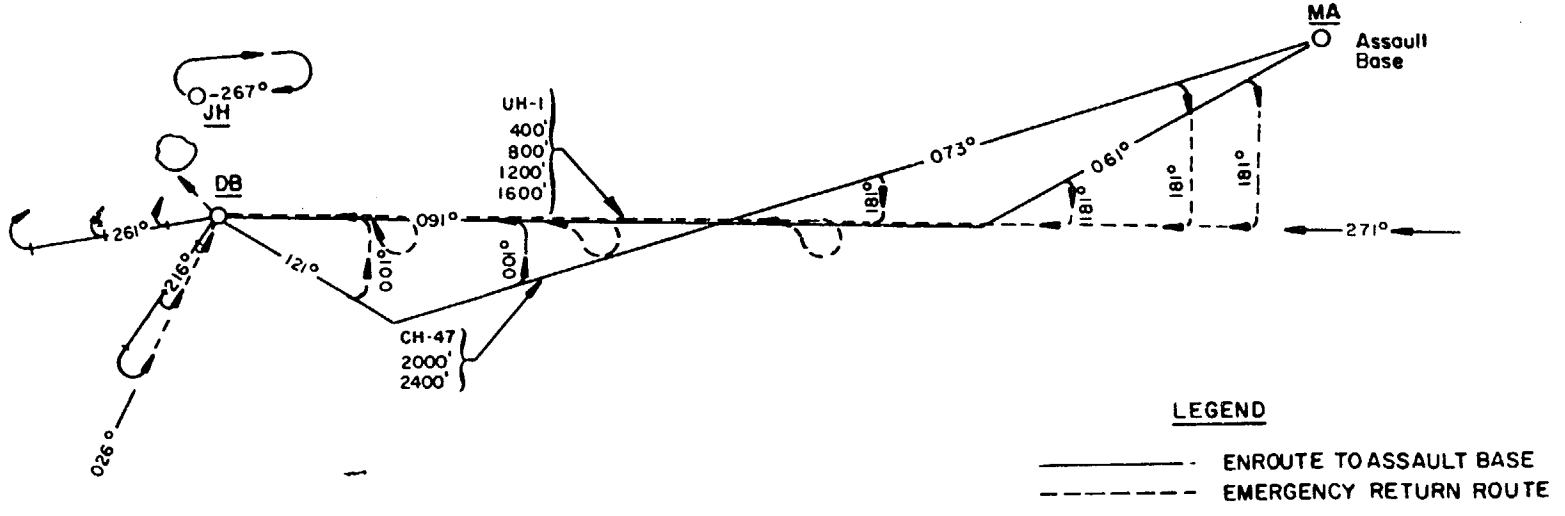


FIG. VI-4 EMERGENCY RETURN AND PENETRATION PROCEDURE - PLAN IV

APPENDIX VII

MODEL A SIMULATION LABORATORY

The function of an ATC Simulation Facility is to provide, through the employment of simulation techniques, an environment in which to study, research, and investigate many of the problems in present and future air traffic control (ATC) systems.

The Model A dynamic ATC Simulator consists of 48 pilot consoles or target generators (FIG. VII-1), associated radar displays, and flight data boards. Capabilities of the Model A target generators include (1) airspeed 0 to 1500 knots; (2) acceleration/deceleration rate 30 to 2,500 nautical miles per minute; (3) altitude 0 to 100,000 feet; (4) climb/descent 0 to 80,000 feet per minute; and (5) rate of turn 0^{o} to 20^{o} per second.

The maximum geographic area which the equipment is capable of simulating (without translating dimension) is 400 x 400 nautical miles.

The target generators provide rho-theta information for a radar system. There are three separate radars available. TI-440 scan converters are used to feed the radar information into either horizontal or vertical radar displays located at either an adjacent operating area or to a remoted operating area.

The Bell 300 System is used to simulate both interphone and air/ground radio communications. A pushbutton dial, located at each control position, is employed to select any two-way simulated radio channel.

Associated with the Model A Simulator is a Data Collection and Recording System. This system automatically records such information as: (1) communications recordings, times and counts; (2) delay times; (3) runway occupancy times; and (6) confliction data and other pertinent measurements.

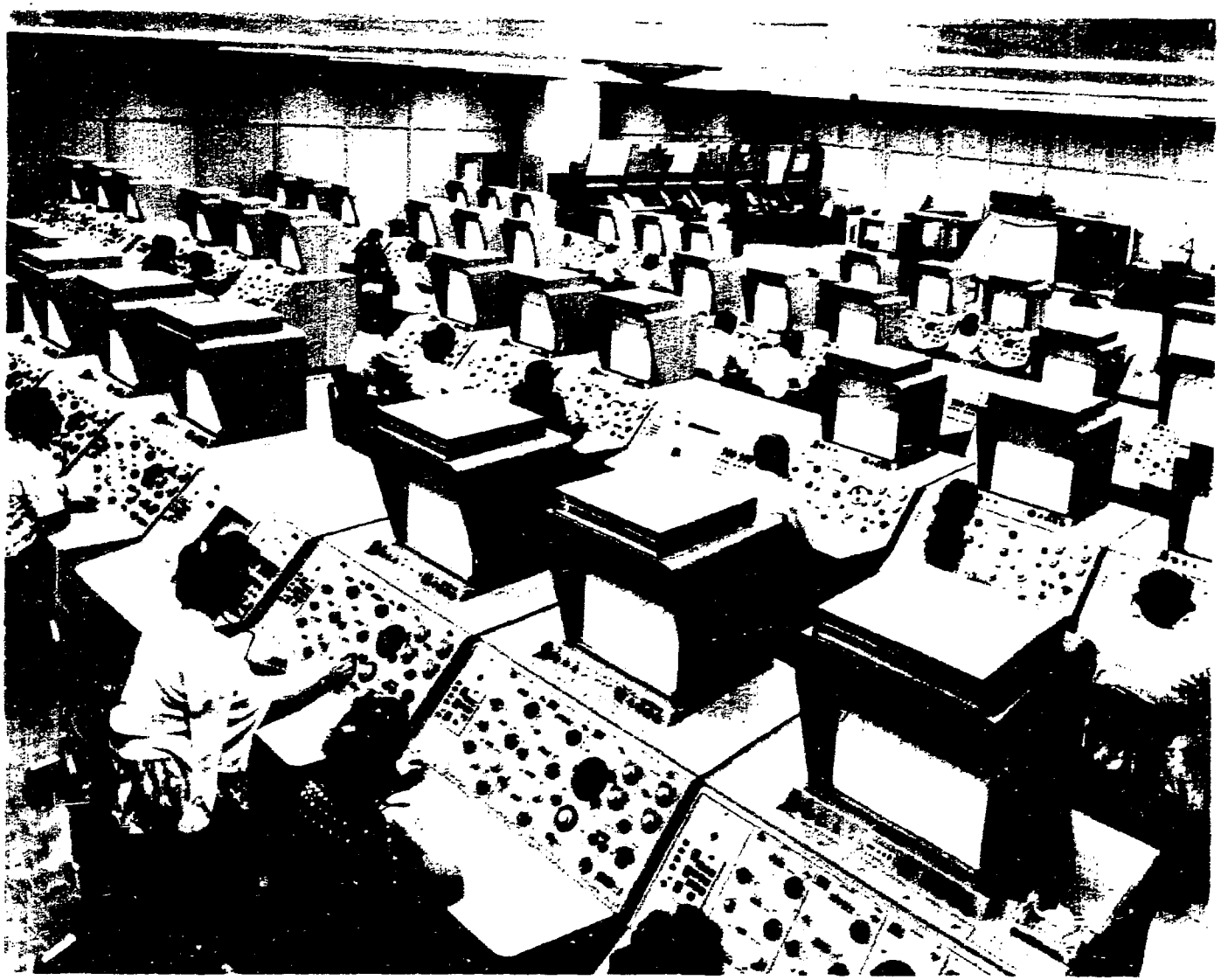


FIG. VII-1 MODEL "A" RADAR TARGET GENERATORS

APPENDIX VIII

CONTROLLERS' SUBJECTIVE OPINION

At the conclusion of the simulation period the controllers completed questionnaires.

The following is a partial list of the questions asked in the questionnaire and a summation of the NAFEC controllers' answers:

A. Based on your observation of the simulation runs, do the following separation values appear realistic for a tactical operation:

1. One-minute separation between successive departures, where the second aircraft climbs to the higher altitude ?

Both controllers gave an affirmative response.

2. Five minutes longitudinal separation between like-type aircraft at the speed of UH-1 helicopters (80 knots) ?

Both controllers gave an affirmative response.

3. Four minutes longitudinal separation between like-type aircraft at the speed of CH-47 helicopters (110 knots) ?

Both controllers gave an affirmative response.

4. Four hundred feet vertical separation ?

Response #1. OK

Response #2. Questioned

5. Three miles either side of center-line of route for airway width ?

Both controllers concurred. However, it was suggested that this be validated by further live testing.

6. A hold-down of five miles with 45 degree divergence for an off-course departure and climb to higher altitude ?

Both controllers gave an affirmative response.

7. Like-type aircraft in trail for the five-mile off-course restriction with one-minute separation and then commencing climb to altitude ?

Response #1. OK

Response #2. No

8. Assuming proper ground control at a dispatch point, does 30 degree divergence between simultaneous departures appear acceptable ?

Response #1. 45 degrees seemed better.

Response #2. Yes, with qualification.

B. Based on your experience as both pilots and controllers, do the approach procedures outlined in this simulation appear reasonably acceptable for a tactical operation ?

Response #1. Yes

Response #2. "Using low power ADF beacon and only 30 second track from beacon may be unsafe to descending aircraft. Also, no way of knowing where the descent leg or bearing would be intercepted after getting a station passage on the ADF, so if after intercepting the bearing and the wait of 30 seconds, you may be more than 30 seconds from the beacon and have a descending copter closer than expected."

C. Is adequate provision made for emergency situations in the event of radio beacon failure at the assault base or deterioration of weather which would cause either one or multiple missed approaches ?

Both controllers gave an affirmative response.

D. Indicate the degree of controller experience considered necessary to operate these plans, distinguishing, if necessary, the difference in complexity between different plans.

Response #1. "Should be a fast thinker with some approach control experience in an Army-type situation."

Response #2. "No special experience, just a good explanation of the different plans."

E. Considering the advance planning necessary to program any one of these plans for a tactical operation, do the minimum communications simulated for controller handling of unusual situations seem sufficient?

Both controllers gave an affirmative response.

F. Please record any other comments on these tactical plans.

Response #1. "Plans were quite adequate, but feel that live testing is the proof needed. I still don't trust beacon with the accuracy demanded in this operation."

NOTE: Comments not pertaining to the question were omitted from this response.

Response #2. "I feel that only live testing will answer the questions on simultaneous departures and the use of ADF approach procedures as applied to all of the plans."

Federal Aviation Agency, Systems Research and Development Service, Evaluation Division, Atlantic City, New Jersey. EVALUATION OF FORWARD AREA ASSAULT FLAPS FOR ARMY HELICOPTER OPERATIONS by Donald O. Brown, February 1965, 39 pp., incl. 19 illus., plus 8 appendices (71 pp.), Final Report. (Project No. 150-530-01V, Report No. RD-65-17)

Unclassified Report

An evaluation of operational plans was conducted to provide the U. S. Army with procedures, separation values, basic navigation and air traffic control requirements for use in helicopter assault missions under instrument flight conditions. The evaluation consisted of dynamic simulation as well as live flight tests.

Live flight tests were conducted by the 11th Air Assault Division, Fort Benning, Georgia, with the assistance of Federal Aviation Agency project personnel to obtain information as to the ability of helicopter pilots to maintain an assigned airspeed, altitude, and track. Data from these tests were used as a partial basis for separation values which were applied to the plans tested in dynamic simulation.

Six operational plans for like and mixed-type helicopters resulted from the simulation. Each plan handled both normal and emergency situations and the movement rates established for each.

Over

UNCLASSIFIED

I. Brown, Donald O.
II. Project No. 150-530-01V
III. Report No. RD-65-17

Descriptors

Air Traffic Control Systems
Armed Forces Transportation
*Army Operations
*Helicopters

UNCLASSIFIED

It was concluded that the procedures, separation values, and equipment requirements as described for each of the six operational plans are adequate for use in conducting helicopter assault missions under instrument conditions. It was further concluded that pilot and controller proficiency are important to the successful conduct of a mission.

It was recommended that these procedures, values, and requirements be considered for use by the U. S. Army and that further live tests be conducted by the Army under actual field conditions.

UNCLASSIFIED

Federal Aviation Agency, Systems Research and Development Service, Evaluation Division, Atlantic City, New Jersey. EVALUATION OF FORWARD AREA ASSAULT FLAPS FOR ARMY HELICOPTER OPERATIONS by Donald O. Brown, February 1965, 39 pp., incl. 19 illus., plus 8 appendices (71 pp.), Final Report. (Project No. 150-530-01V, Report No. RD-65-17)

Unclassified Report

An evaluation of operational plans was conducted to provide the U. S. Army with procedures, separation values, basic navigation and air traffic control requirements for use in helicopter assault missions under instrument flight conditions. The evaluation consisted of dynamic simulation as well as live flight tests.

Live flight tests were conducted by the 11th Air Assault Division, Fort Benning, Georgia, with the assistance of Federal Aviation Agency project personnel to obtain information as to the ability of helicopter pilots to maintain an assigned airspeed, altitude, and track. Data from these tests were used as a partial basis for separation values which were applied to the plans tested in dynamic simulation.

Six operational plans for like and mixed-type helicopters resulted from the simulation. Each plan handled both normal and emergency situations and the movement rates established for each.

Over

UNCLASSIFIED

I. Brown, Donald O.
II. Project No. 150-530-01V
III. Report No. RD-65-17

Descriptors

Air Traffic Control Systems
Armed Forces Transportation
*Army Operations
*Helicopters

UNCLASSIFIED

It was concluded that the procedures, separation values, and equipment requirements as described for each of the six operational plans are adequate for use in conducting helicopter assault missions under instrument conditions. It was further concluded that pilot and controller proficiency are important to the successful conduct of a mission.

It was recommended that these procedures, values, and requirements be considered for use by the U. S. Army and that further live tests be conducted by the Army under actual field conditions.

UNCLASSIFIED